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13. ABSTRACT (Maximum 200 words)
The John A. Volpe National Transportation Systems Center (Volpe Center), in support of the Federal Aviation administration, Office of Environment and Energy, has developed Version 4.11 of the Integrated Noise Model (INM). The User's Guide for the Version 4.11 computer software is a supplement to INM, Version 3, User's Guide - Revision 1 for the Version 3.10 computer software released in June, 1992. The Version 4.11 supplement, prepared by the Volpe Center's Acoustics Facility, presents computer system requirements as well as installation procedures and enhancements. Specific enhancements discussed include: (1) the introduction of a takeoff profile generator; (2) the ability to account for terrain elevation around a specified airport; (3) the ability to compute the CNEL, WECPNL, LEQDAY, and LEQNIGHT noise metrics; (4) the ability to account for airplane runup operations; (5) the ability to account for displaced runway thresholds during approach operations; (6) an enhancement to the noise contour computations: (7) an increase in the number of takeoff profile segments; and (8) enhancements to the echo file.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3

NOTE: Volumes greater than 1000 l shall be shown in m^3.

Symbol	When You Know	Multiply By	To Find	Symbol
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
psi	poundforce per square inch	6.89	kilopascals	kPa

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Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.195	square yards	ac
ha	hectares	2.47	acres	mi^2
km^2	kilometers squared	0.386	square miles	
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m^3	meters cubed	35.71	cubic feet	ft^3
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g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
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°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
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* SI is the symbol for the International System of Units

(Revised January 1992)

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(Revised January 1992)

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1.1 Computer System Requirements

INM Version **4.11** operates on an IBM Personal Computer (PC) -Compatible platform with the following minimum configuration:

- IBM PC-AT or compatible, Series **286** microprocessor;
- 3 MB of available hard disk space;
- **590 KB** of Random Access Memory (RAM) or 3 MB of **RAM**, if operating the **INM** from a RAM disk, as discussed in Section **1.2.1** below;
- Math co-processor, Series **80287**; and
- Microsoft-compatible Disk Operating System (**MSDOS**) Version **3.3**.

In addition, the **CONFIG.SYS** file on the PC slated for **INM** Version **4.11** installation must contain the following lines: **BUFFERS=30**; and **FILES=30**.

1.2 Installation

The files on the **INM** Version **4.11** system diskette have been stored in a compressed format using the **PKZIP** Version **1.1** utility software [Copyright (**c**) **1990 PKWare**, Inc.]. With the source drive prompt displayed on the screen, execute the UNPACK batch file to install **INM** Version **4.11** on your PC:

- **UNPACK <SOURCE DRIVE> <TARGET DRIVE>**

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- **UNPACK <SOURCE DRIVE> <TARGET DRIVE>**

This will assign the RAM drive, i.e., the D-drive, to operate within the subdirectory **C:\RAM** on the hard drive. Note: It is extremely important to remember that each time the PC is reset or its power is turned off, the information stored on the **RAM** drive will be lost. As a result, if the **INM** is run from the RAM drive, all files must be copied to a physical drive, e.g., a floppy drive, prior to powering-off the PC.

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2. IMPLEMENTATION OF INM VERSION 4.11 ENHANCEMENTS

This Section of the document describes the methodology for implementing INM Version 4.11 enhancements. It includes a background discussion of the enhancements, a brief discussion of the need for the enhancements, and example implementation of the enhancements. The following enhancements are discussed: (1) the takeoff profile generator; (2) the ability to account for terrain elevation around a specified airport; (3) the ability to compute the CNEL, WECPNL, LEQDAY, and LEQNIGHT noise metrics; (4) the ability to account for airplane runup operations; (5) the ability to account for runway thresholds during approach operations; (6) an enhancement to the noise contour computations; (7) an increase in the number of takeoff profile segments; and (8) enhancements to the echo file.

2.1 Takeoff Profile Generator

This enhancement allows for the computation of airplane takeoff profiles based on the user-supplied airport elevation and temperature entry in the SETUP section of the INM input file. The takeoff profiles are utilized by the INM in the computation of all noise metrics. Previous versions of the INM utilize takeoff profiles which were based on standard-day conditions, i.e., temperature of 59°F and airport elevation of zero ft Above Mean Sea Level (MSL). Previously, the user-supplied airport elevation (altitude) and temperature were only used to compute an atmospheric acoustic impedance correction.

The takeoff profile generator is made possible by the inclusion of standardized airplane operating procedures and performance coefficients in Data Base Number 11. These procedures and coefficients are presented in References 2, 3, and 4, and accessible from the Data Base using the ACDB11.EXE computer program, supplied with the Version 4.11 release. With the exception of INM airplane numbers 1, 6, 7, 8, 10, 24, 56, 100, 101, and four of the new airplanes (INM airplane numbers 104 to 107) discussed further in Appendix A, the operating procedures and performance coefficients required for takeoff profile computation are included in Data Base Number 11. For the airplanes without standard procedures and coefficients the takeoff profile for standard conditions is assumed regardless of the airport elevation and temperature. Note: The incorporation of the takeoff profile generator will not affect the standard approach profiles. The approach profiles are the same as employed in INM Version 3.10.

Operation of the profile generator is time-efficient and entirely transparent to the user. If other than standard-day conditions are specified by the user in the SETUP portion of the input file, the profile generator automatically computes the takeoff profiles using the airplane performance coefficients in Data Base Number 11 and the equations in the

Society of Automotive Engineers Aerospace Information Report 1845 (SAE/AIR 1845). When an airport elevation and temperature is not specified, the INM assumes standard conditions and utilizes the standard profiles included with Data Base Number 11, i.e., the internal profile generator will not be exercised.

To insure the takeoff profiles and resultant noise metrics computed by INM Version 4.11 are reasonable for the user-defined input case, a runway length check has been instituted. When the computed ground roll segment of the takeoff profile exceeds the user-specified runway length, the user is notified of the discrepancy. A message similar to the following is included in the echo file.

- **WARNING: COMPUTED GROUND ROLL ERROR FOR INM AIRPLANE 747200, STAGE WEIGHT 7, -- EXCEEDS USER-DEFINED RUNWAY LENGTH BY X PERCENT FOR THE TAKEOFF ON TRACK TR1,RUNWAY 09L.**

In many cases this warning will indicate to the user that there is an error in the input file, possibly in the user-defined average yearly temperature, airport elevation, airport runway length, or airplane stage weight. In cases where the computed ground roll segment exceeds the runway length by more than 10 percent, the above message will be included in the echo file as a fatal error rather than a warning and the user will not be permitted to continue processing of the input case.

There may be instances where the user has correctly defined the input case and the computed ground roll segment exceeds the runway length by more than 10 percent. This apparent anomaly may be the result of using the average yearly temperature at the airport as an input. For example, a particular airport may be capable of operating a high stage-weight B747 airplane in the early evening or during winter months only, when the temperature is significantly lower than the average yearly temperature. In such cases it is suggested that a user-defined profile be included in the input file.

In addition, there may be instances (e.g., high stage weights, high temperatures, and high airport elevations combined) where a negative rate-of-climb is computed. Consequently, a fatal error will occur and a profile will not be generated. In such instances, the user will be notified with a message similar to that below; it is suggested that a user-defined profile be included in the input file.

- **FATAL: PROFILE FOR INM AIRPLANE 747200, STAGE WEIGHT 7 CANNOT BE COMPUTED.**

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- **FATAL: PROFILE FOR INM AIRPLANE 747200, STAGE WEIGHT 7 CANNOT BE COMPUTED.**

longitude of a reference point at the airport (e.g., the beginning of the primary runway). In the following example the latitude and longitude are for the start of Runway **09L** at Boston-Logan.

- **ENTER 3 LETTER AIRPORT IDENTIFIER (EX. BOS):** BOS
- **ENTER RUNWAY LAT COORD. DEGS MINS SECS (EX. 42 21 20):** 42 21 20
- **ENTER RUNWAY LON COORD. DEGS MINS SECS (EX. 71 00 48):** 71 00 48

The **MAKEFILE.EXE** program then computes the coordinates of the southeast corner of a one-degree by one-degree data-block based upon the start of the airport's primary runway being at the geographic center of the block. The computed southeast corner is displayed along with the four **RMC DEM** files required to construct the one-degree by one-degree data-block around the airport. The user is also given the option to overwrite an existing or create a new **BOS.3CD** file, where **BOS** is the three-letter airport identifier.

- **THE SE CORNER OF THE REQUIRED (1X1 DEG) DATA BLOCK IS: 41 52 70 31**
- **THE REQUIRED DEM FILES ARE: NW FN=42071.3CD NE FN=42070.3CD**
  SW FN=41071.3CD SE FN=41070.3CD
- **DO YOU WISH TO CREATE A NEW BOS.3CD FILE (Y/N) ? Y**

The user should type **Y** to overwrite/create a new file. If the four **DEM** files exist in the current directory, the program will create the **BOS.3CD** file without further prompting. If **MAKEFILE.EXE** cannot find the required **DEM** files, it will request that the user enter the drive where the **DEM** files are resident. In addition, **MAKEFILE.EXE** will ask if the data are on the **RMC** CD-ROM and, if so, copy them into the current directory. If the four **DEM** files are not on the CD-ROM drive, **MAKEFILE.EXE** will request the path where the files can be found. The program will then construct the required **one**-degree by one-degree data-file, with the airport's primary runway at its approximate geographic center. The user will be informed that the file has been constructed, and the minimum and maximum elevation within the constructed one-degree by one-degree block will be provided.

- **WRITING OF BOS.3CD IS COMPLETE**

The example **BOS.3CD** file is now ready for implementation by the **INM**. To utilize the elevation data in the **BOS.3CD** file in the computation of source-to-receiver slant range, the user must specify, in the SETUP portion of the **INM** input file: (1)

the three-letter airport code which identifies the specific user pre-processed .3CD file; (2) the disk-drive location of the .3CD file (Note: It is not necessary to specify the location of the .3CD file if it is in the current directory; also, if the .3CD file resides in a subdirectory, the path to that subdirectory must be created prior to running INM.); and (3) the latitude and longitude of a user-defined reference point at the airport, where the X and Y coordinates of all defined runways must be referenced to this point. To insure that the user has identified the appropriate .3CD file, the INPUT.EXE program will test the user-defined reference point at the airport against the stored reference in the .3CD file.

In the following example the user has: (1) specified Boston's Logan International Airport; (2) identified the C-drive as the location for the BOS.3CD file; and (3) specified the latitude and longitude of a reference point at Boston-Logan.

- **SETUP:**

  TITLE <EXAMPLE IMPLEMENTATION OF ELEVATION ENHANCEMENT>
  AIRPORT <ELEVATION EXAMPLE>

  CODE BOS
  DRIVE C
  LATITUDE 42 21 20
  LONGITUDE 71 00 48

With the elevation enhancement invoked as described above, all noise-level computations are performed based upon the actual source-to-receiver slant range, rather than assuming a flat terrain as was the case in previous versions of the INM.

In addition, the data in the BOS.3CD file are used to compute the slope of a three-by-three arc-second tangential ground plane, with the receiver at its physical center. This ground plane is used in the computation of the source-to-receiver elevation-angle, beta, required by the lateral attenuation algorithm in the INM. The beta angle is defined as the angle subtended by the propagation path from the airplane to the receiver and the three-by-three arc-second ground plane. Figures 2-1 and 2-2, respectively, depict the beta angle for two scenarios: (1) previous versions of the INM (i.e., flat terrain); and (2) INM Version 4.11.

2.3 CNEL, WECPNL, LEQDAY, and LEQNIGHT Noise Metrics

The capability to compute four additional noise metrics has been included in INM Version 4.11. They are the Community Noise Equivalent Level (CNEL), Weighted Equivalent Continuous Perceived Noise Level (WECPNL), Equivalent Sound Level During Daytime Hours (LEQDAY), and Equivalent Sound Level During Nighttime Hours (LEQNIGHT). The addition of these four metrics brings the total number of metrics available for computation by the INM to eight (NEF, LEQ, LDN, TA, CNEL, WECPNL, LEQDAY, and LEQNIGHT). As was the case in previous the three-letter airport code which identifies the specific user pre-processed .3CD file; (2) the disk-drive location of the .3CD file (Note: It is not necessary to specify the location of the .3CD file if it is in the current directory; also, if the .3CD file resides in a subdirectory, the path to that subdirectory must be created prior to running INM.); and (3) the latitude and longitude of a user-defined reference point at the airport, where the X and Y coordinates of all defined runways must be referenced to this point. To insure that the user has identified the appropriate .3CD file, the INPUT.EXE program will test the user-defined reference point at the airport against the stored reference in the .3CD file.

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2.3 CNEL, WECPNL, LEQDAY, and LEQNIGHT Noise Metrics

The capability to compute four additional noise metrics has been included in INM Version 4.11. They are the Community Noise Equivalent Level (CNEL), Weighted Equivalent Continuous Perceived Noise Level (WECPNL), Equivalent Sound Level During Daytime Hours (LEQDAY), and Equivalent Sound Level During Nighttime Hours (LEQNIGHT). The addition of these four metrics brings the total number of metrics available for computation by the INM to eight (NEF, LEQ, LDN, TA, CNEL, WECPNL, LEQDAY, and LEQNIGHT). As was the case in previous versions of the INM, Version 4.11 allows for the computation of all metrics simultaneously in grid mode or a single user-defined metric in contour mode for a given input case. A brief description of the CNEL, WECPNL, LEQDAY, and LEQNIGHT noise metrics follows:

(1) Community Noise Equivalent Level (CNEL): The CNEL noise metric, which is primarily used in California, is similar to the Day-Night Sound Level (LDN) metric in that it incorporates the energy-averaged A-weighted sound level integrated over a 24-hour period. However, unlike LDN, CNEL incorporates an additional penalty for operations occurring between the evening hours of 1900 and 2200 hours. For CNEL, a 3 dB penalty is applied to operations occurring between 1900 and 2200 hours, and a 10 dB penalty is applied to operations occurring between 2200 and 0700 hours. The equation for computing CNEL within the INM is as follows:

$$CNEL = SEL + 10\log_{10}(N_{day} + 3N_{eve} + 10N_{night}) - 49.4,$$

where SEL = Sound Exposure Level in dBA;

N_{day} = number of operations between 0700 and 1900 hours local time;

N_{eve} = number of operations between 1900 and 2200 hours local time;

N_{night} = number of operations between 2200 and 0700 hours local time;

and 49.4 = constant which normalizes CNEL to a 24-hour period, (i.e., $10\log_{10}(1/86{,}400$ sec/day$) = -49.4$).

(2) Weighted Equivalent Continuous Perceived Noise Level (WECPNL): The WECPNL noise metric, which is primarily used by the European Community, is based upon the PNLT noise metric and is computed within the INM as follows:

$$WECPNL = EPNL + 10\log_{10}(N_{day} + 3N_{eve} + 10N_{night}) - 39.4,$$

where all definitions are the same as in CNEL, above, except:

EPNL = Effective Perceived Noise Level in dB; and

39.4 = (49.4 - 10); where 49.4 is the constant which normalizes WECPNL to a 24-hour period, (i.e., $10\log_{10}(1/86,400$ secs/day$) = -49.4$); and -10 is the duration normalizing factor in the definition of EPNL.[6]

(3) Equivalent Sound Level During Daytime Hours (LEQDAY): The LEQDAY noise metric is an energy summation of the aggregate environment, as measured in A-weighted decibel units (dBA) normalized to the 15-hour time period from 0700 to 2200. The equation for computing LEQDAY within the INM is as follows:

$$LEQDAY = SEL + 10\log_{10}(N_{day} + N_{eve}) - 47.3,$$

where all definitions are the same as in CNEL, above, except:

47.3 = constant which normalizes LEQDAY to the 15-hour period from 0700 to 2200, (i.e., $10\log_{10}(1/54,000$ sec$) = -47.3$).

(4) Equivalent Sound Level During Nighttime Hours (LEQNIGHT): The LEQNIGHT noise metric is an energy summation of the aggregate environment, as measured in A-weighted decibel units (dBA) normalized to the 9-hour time period from 2200 to 0700. The equation for computing LEQNIGHT within the INM is as follows:

$$LEQNIGHT = SEL + 10\log_{10}(N_{night}) - 45.1,$$

where all definitions are the same as in CNEL, above, except:

45.1 = constant which normalizes LEQNIGHT to the 9-hour period from 2200 to 0700, (i.e., $10\log_{10}(1/32,400$ sec$) = -45.1$).

2.4 Airplane Runup Operations

This enhancement allows INM Version 4.11 to compute noise levels due to airplane engine runup operations. The need for this particular enhancement is recognized primarily around airplane maintenance facilities. To invoke this capability the user must define an airplane runup in the TAKEOFF section of the input file as follows:

-
```
INT.INM.
TAKEOFFS BY FREQUENCY:

TRACK RU1 RWY 09L STRAIGHT 50
      OPERATION 747200 RUNUP 1 D=30
      OPERATION 747200 STAGE 4 D=80
                 <OR>
      OPERATION 747200 STAGE 4 D=80 RUNUP 1 D=30
```

(i.e., $10\log_{10}(1/86,400$ secs/day) = -49.4); and -10 is the duration normalizing factor in the definition of EPNL.[6]

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$$LEQNIGHT = SEL + 10\log_{10}(N_{night}) - 45.1,$$

where all definitions are the same as in CNEL, above, except:

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- INT.INM.

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TAKEOFFS BY FREQUENCY:

TRACK RU1 RWY 09L STRAIGHT 50
      OPERATION 747200 RUNUP 1 D=30
      OPERATION 747200 STAGE 4 D=80
                     <OR>
      OPERATION 747200 STAGE 4 D=80 RUNUP 1 D=30
```

In addition, the specific location, e.g., the start of a runway or at a maintenance facility, and heading of the runup operation in the above user-defined example must be specified in the RUNWAYS section of the input file as discussed earlier in this section. A technical discussion of the airplane engine runup capability is presented in Appendix C.

2.5 Approach Runway Thresholds

The capability to account for displaced runway thresholds for approach operations has been added to INM Version 4.1. In previous versions of the INM, the runway touch-down point was assumed to be a fixed 954 ft from the edge of the runway for airplanes with a three degree approach glide slope, and 572 ft for the four airplanes with a five degree approach glide slope (INM airplane numbers 74 to 77). With INM Version 4.1, a user-defined displaced threshold (DT), either positive or negative, is added to the fixed runway touch-down point. To insure realistic DT's are defined by the user, they are checked versus the runway coordinates. If discrepancies exist, the user is notified in the echo file, as appropriate. In the following example, a 1454 ft runway touch-down point has been defined in the SETUP section of the input file for Runway 09L (i.e., 500 ft for the user-defined DT plus 954 ft for the fixed touch-down point); and a runway touch-down point of 954 ft has been defined for Runway 27R:

- SETUP:

```
TITLE <EXAMPLE IMPLEMENTATION OF APPROACH RUNWAY THRESHOLD>
AIRPORT <RUNWAY THRESHOLD EXAMPLE>

ALTITUDE 23
TEMPERATURE 12.6 C

RUNWAYS
     RW 09L-27R  0 0 DT 500 TO 9487 -497 DT 0
                          <OR>
     RW 09L-27R  0 0 DT 500 TO 9487 -497
```

The above runway definition is depicted graphically below:

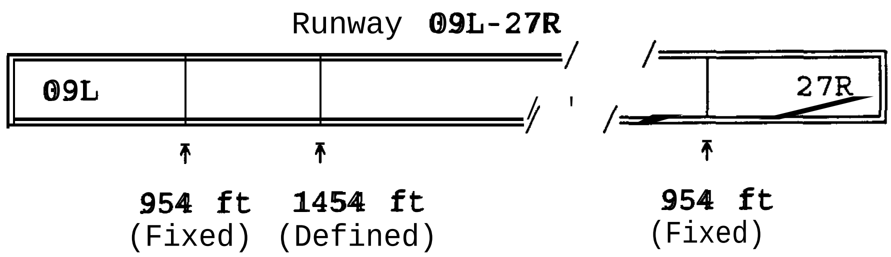

FIGURE 2-3: RUNWAY DEFINITION

In addition, the specific location, e.g., the start of a runway or at a maintenance facility, and heading of the runup operation in the above user-defined example must be specified in the RUNWAYS section of the input file as discussed earlier in this section. A technical discussion of the airplane engine runup capability is presented in Appendix C.

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- **SETUP:**

```
TITLE <EXAMPLE IMPLEMENTATION OF APPROACH RUNWAY THRESHOLD>
AIRPORT <RUNWAY THRESHOLD EXAMPLE>

ALTITUDE 23
TEMPERATURE 12.6 C

RUNWAYS
      RW 09L-27R  0 0 DT 500 TO 9487 -497 DT 0
                             <OR>
      RW 09L-27R  0 0 DT 500 TO 9487 -497
```

The above runway definition is depicted graphically below:

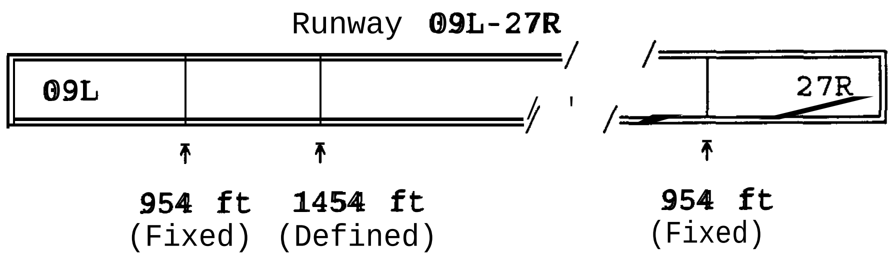

FIGURE 2-3: RUNWAY DEFINITION

3. REFERENCES

1 Flythe, M.C., Integrated Noise Model Version 3, User's Guide - Revision 1, Report No. DOT/FAA/EE-92/02, Arlington, VA: CACI, Inc. - Federal, June 1992.

2 Bishop, D.E., Mills, J.F., Update of Aircraft Profile Data for the Integrated Noise Model Computer Program, Volume 1, Report No. FAA-EE-91-02, Canoga Park, CA: Acoustical Analysis Associates, Inc., March 1992.

3 Bishop, D.E., Mills, J.F., Update of Aircraft Profile Data for the Integrated Noise Model Computer Program, Volume 2, Report No. FAA-EE-91-02, Canoga Park, CA: Acoustical Analysis Associates, Inc., March 1992.

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6 Federal Aviation Regulations, Part 36, Noise Standards: Aircraft Type and Airworthiness Certification, Washington, D.C.: Federal Aviation Administration, December 1988.

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APPENDIX A

REVISIONS TO INM ALGORITHMS

This Appendix discusses, in general terms, revisions to several algorithms and subroutines included in INM Version 4.11. It also discusses the rationale for these revisions and presents their effects on the noise contours, where applicable. The associated computer source code is not included. All revisions discussed below are transparent to the user in that they do not affect user-operation of the INM. However, these revisions will result in more accurate INM noise predictions and an increase in INM computational efficiency. They include: (1) revisions to the flight significance testing within the INM; (2) implementation of a directivity smoothing equation; (3) revisions to the dipole directivity pattern within the INM; and (4) revisions to the INM Data Base.

A.1 Flight Significance Testing.

The methodology employed for determining flight noise significance during grid computations has been streamlined in INM Version 4.11. Rather than looping through each of the first four refinement levels individually and constructing the noise grid on a level-by-level basis, INM Version 4.11 begins by constructing the 17-by-17 point regular grid previously associated with the fourth refinement level, and setting all parameters associated with the 289 total points, including the noise significance flags for each point.

In restructuring the flight significance methodology, it was discovered that INM Version 3.10 was performing unnecessary (i.e., insignificant) noise computations due to improper setting of the flight significance flags. This impropriety had no effect on the computed noise levels but it did increase run-time unnecessarily. Revising the methodology for grid development, including the proper setting of flight significance flags, improved computation time by an estimated 40 percent over INM Version 3.10, for comparable input cases.

A.2 Directivity Smoothing Equation

The directivity algorithm of SAE/AIR1845 implemented for receivers behind start-of-takeoff roll, which is based on field-measured data published in 1980, has been maintained within INM Version 4.11. However, a directivity smoothing equation, operating as a function of distance, has been implemented. In previous versions of the INM, the directivity algorithm is applied to noise levels behind start-of-takeoff-roll regardless of lateral distance. In the 1980 study, measurements were made at distances from start-of-takeoff-roll of only 970 to 1280 ft. Recent studies[6,7] have indicated that INM Version 3.10 tends to underpredict noise levels behind start-of-takeoff-roll at distances of 3000 to 5000 ft, well beyond those represented in the 1980 study. This underprediction was especially evident for measurements made directly behind the airplane where

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The effect of the modified directivity pattern on the noise contours is depicted in Figures A-3 and A-4, below. Figure A-3 shows the effect on the SEL footprint for a single takeoff operation of the B737-200 airplane (INM number 47). Figure A-4 shows the effect on the LDN contour for the INM Input Testcase provided with INM Version 3.10.

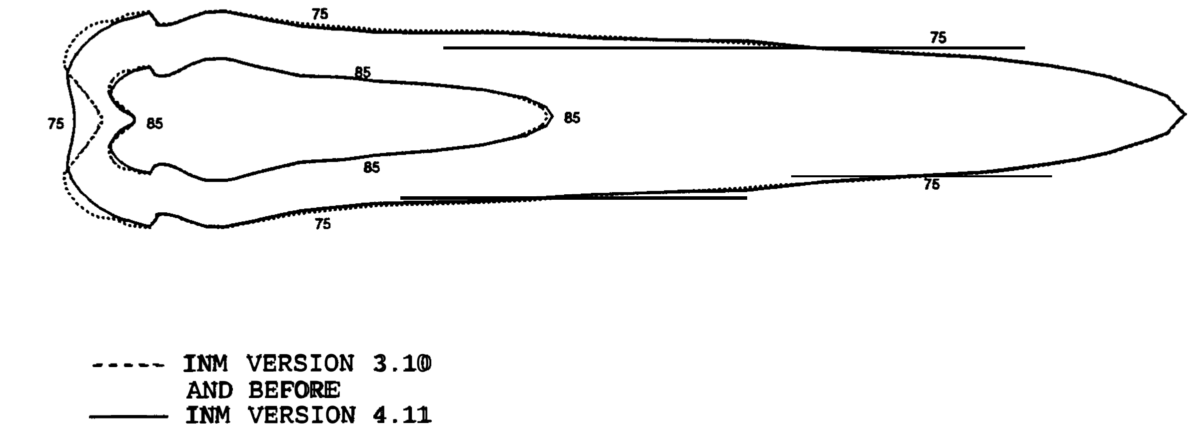

FIGURE A-3: SEL TAKEOFF FOOTPRINT COMPARISON FOR B737-200 AIRPLANE

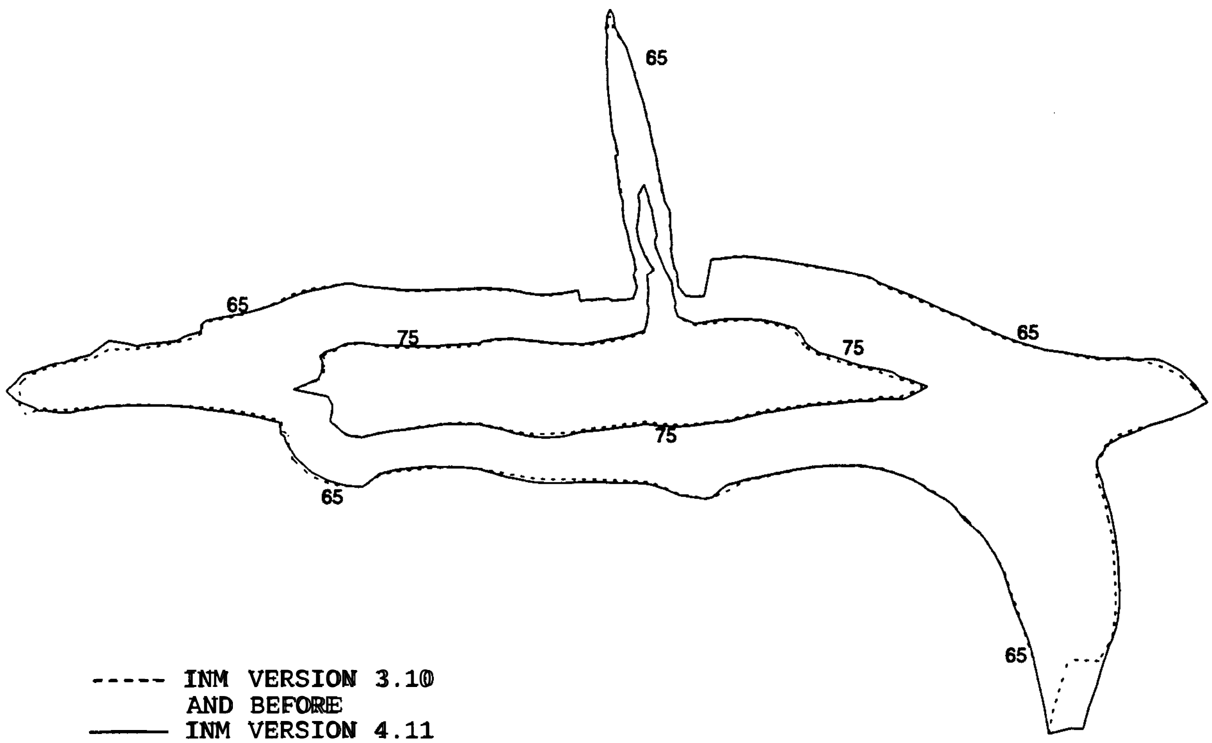

FIGURE A-4: LDN CONTOUR COMPARISON FOR INM INPUT TESTCASE

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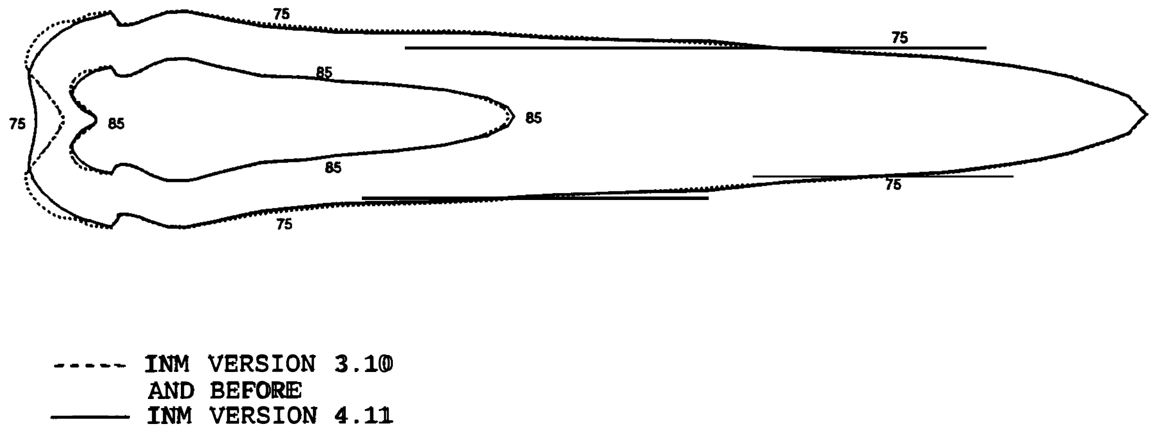
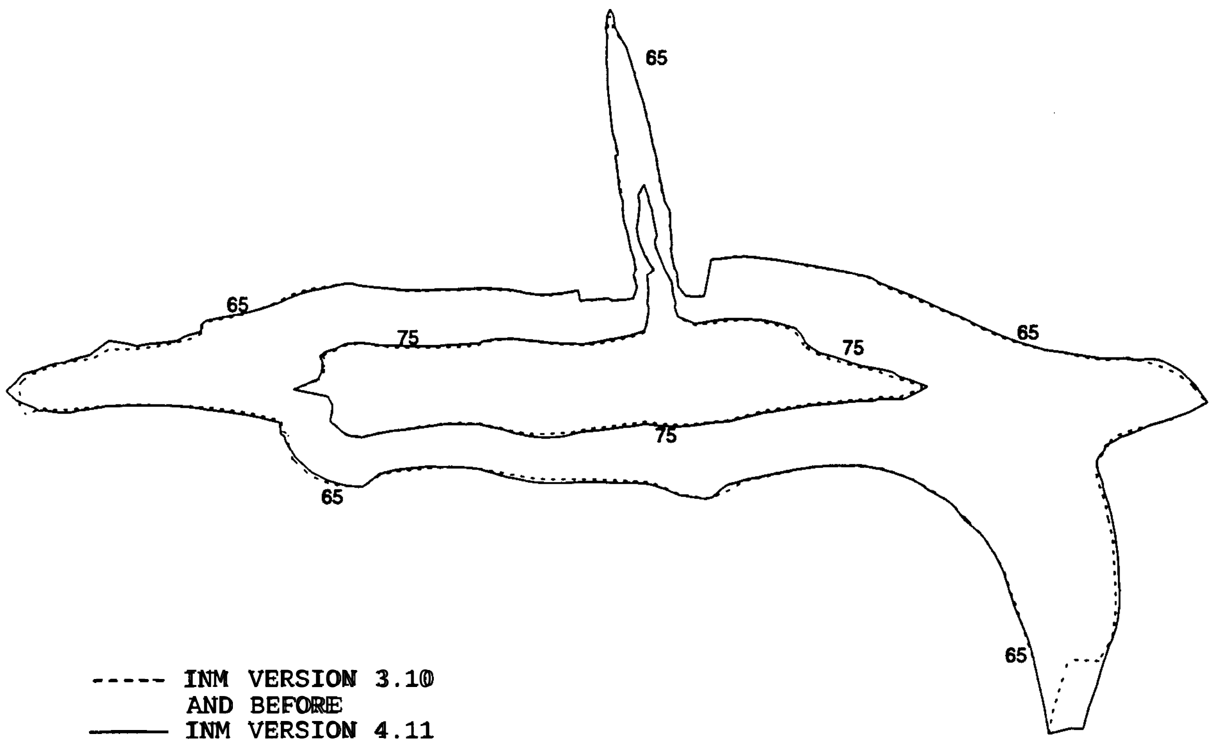


FIGURE A-3: SEL TAKEOFF FOOTPRINT COMPARISON FOR B737-200 AIRPLANE



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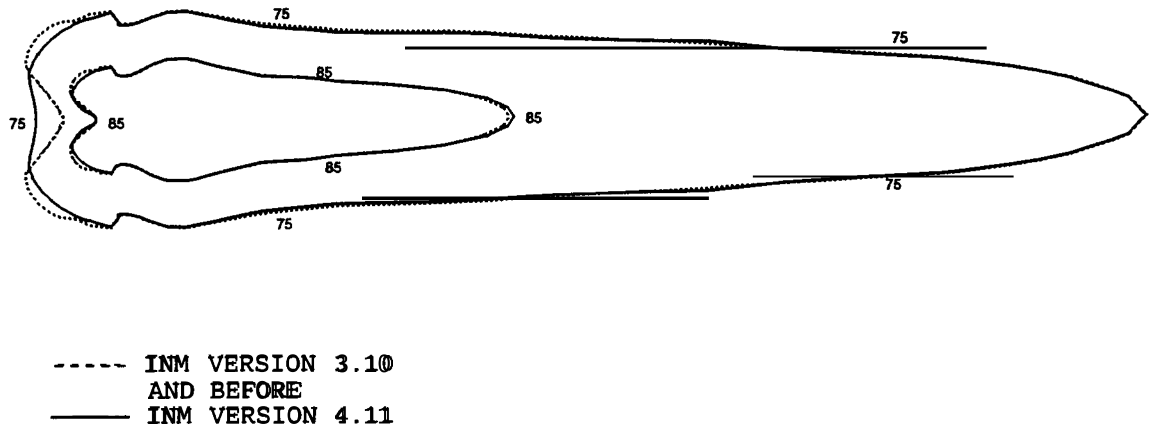

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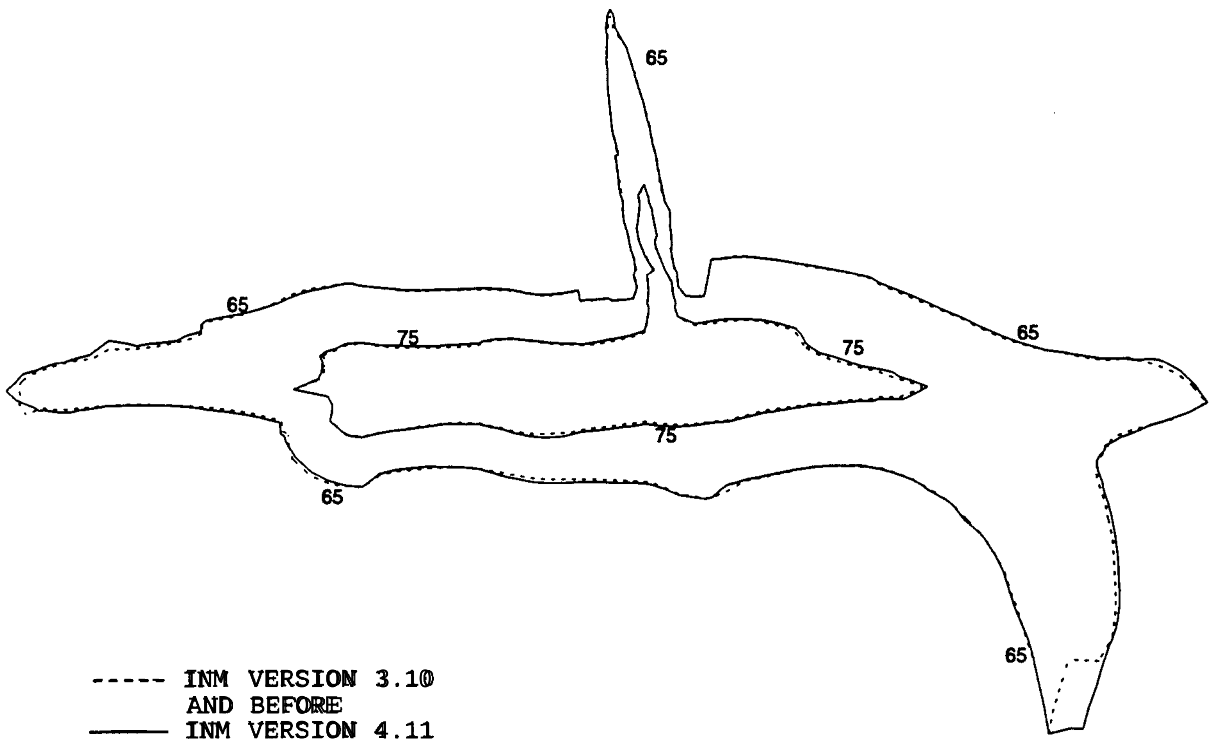

FIGURE A-4: LDN CONTOUR COMPARISON FOR INM INPUT TESTCASE

Standard Temperature, °F:	T_{fap}	=	T_{f0}	=	59.0
Standard Temperature, °C:	T_{cap}	=	T_{c0}	=	15.0
Standard Temperature, °R:	T_{rap}	=	T_{r0}	=	518.67
Temperature Ratio:	THETA	=	$1-[(L)(H_x)/T_{r0}]$, where H_x is the altitude MSL for segment point X		
Pressure Ratio:	DELTA	=	$\mathrm{THETA}^{[g/((Rc)(L))]}$		
Density Ratio:	SIGMA	=	$\mathrm{THETA}^{[(g/((Rc)(L)))-1]}$		
Airport Elevation MSL:	H_{ap}	=	0.0 ft		
Brake Release Gross Weight		=	W		
Number of Engines supplying Thrust		=	N		

GROUND ROLL SEGMENT

For the ground roll segment the following apply:

Airport Temperature:	T_{c1}	=	T_{c2}	=	T_{cap}
Pressure Altitude MSL:	H_1	=	H_2	=	H_{ap}
Initial Calibrated Airspeed:	V_{c1}	=	16.0 kts		

Given the above, the remaining parameters for the ground roll segment are computed as follows:

Initial Thrust:	Th_1	=	$E + F(V_{c1}) + G_1(H_1) + G_2(H_1)^2 + H(T_{c1})$
Final Calibrated Airspeed:	V_{c2}	=	$(C)(W)^{1/2}$
Final Airplane True Speed:	V_{t2}	=	$V_{c2}/(\mathrm{SIGMA})^{1/2}$
Final Thrust:	Th_2	=	$E + F(V_{c2}) + G_1(H_2) + G_2(H_2)^2 + H(T_{c2})$
Segment Horizontal Length:	S_g	=	$[(B)(\mathrm{THETA})(W/\mathrm{DELTA})^2]/[(N)Th_2]$

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for maximum takeoff thrust mode;

C is a coefficient from Data Base Number 11 which is appropriate to the takeoff flap/slat setting;

B is a coefficient from Data Base Number 11 which is appropriate to a specific airplane/flap-deflection combination, and varies only with the takeoff flap/slat setting; and

SIGMA, THETA, and DELTA, defined above, are constants equal to 1 at sea level.

Standard Temperature, °F:	T_{fap}	$\equiv$	T_{f0}	$\equiv$	59.0
Standard Temperature, °C:	T_{cap}	$\equiv$	T_{c0}	$\equiv$	15.0
Standard Temperature, °R:	T_{rap}	$\equiv$	T_{r0}	$\equiv$	518.67
Temperature Ratio:	THETA	$\equiv$	$1-[(L)(H_x)/T_{r0}]$, where H_x is the altitude MSL for segment point X		
Pressure Ratio:	DELTA	$\equiv$	$\text{THETA}^{[g/((Rc)(L))]}$		
Density Ratio:	SIGMA	$\equiv$	$\text{THETA}^{[(g/((Rc)(L)))-1]}$		
Airport Elevation MSL:	H_{ap}	$\equiv$	0.0 ft		
Brake Release Gross Weight		$\equiv$	W		
Number of Engines supplying Thrust		$\equiv$	N		

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For the ground roll segment the following apply:

Airport Temperature:	T_{c1}	$\equiv$	T_{c2}	$\equiv$	T_{cap}
Pressure Altitude MSL:	H_1	$\equiv$	H_2	$\equiv$	H_{ap}
Initial Calibrated Airspeed:	V_{c1}	$\equiv$	16.0 kts		

Given the above, the remaining parameters for the ground roll segment are computed as follows:

Initial Thrust:	Th_1	$\equiv$	$E + F(V_{c1}) + G_1(H_1) + G_2(H_1)^2 + H(T_{c1})$
Final Calibrated Airspeed:	V_{c2}	$\equiv$	$(C)(W)^{1/2}$
Final Airplane True Speed:	V_{t2}	$\equiv$	$V_{c2}/(\text{SIGMA})^{1/2}$
Final Thrust:	Th_2	$\equiv$	$E + F(V_{c2}) + G_1(H_2) + G_2(H_2)^2 + H(T_{c2})$
Segment Horizontal Length:	S_g	$\equiv$	$[(B)(\text{THETA})(W/\text{DELTA})^2]/[(N)\,Th_2]$

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for maximum takeoff thrust mode;

C is a coefficient from Data Base Number 11 which is appropriate to the takeoff flap/slat setting;

B is a coefficient from Data Base Number 11 which is appropriate to a specific airplane/flap-deflection combination, and varies only with the takeoff flap/slat setting; and

SIGMA, THETA, and DELTA, defined above, are constants equal to 1 at sea level.

Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

ACCELERATION SEGMENT

For acceleration segments the following apply:

Initial Calibrated Airspeed:	V_{c1}	=	V_{c2} of the previous segment
Initial Airplane True Speed:	V_{t1}	=	V_{t2} of the previous segment
Initial Thrust:	Th_1	=	Th_2 of the previous segment
Initial Temperature:	T_{c1}	=	T_{c2} of the previous segment
Initial Pressure Altitude MSL:	H_1	=	H_2 of the previous segment
Final Calibrated Airspeed:	V_{c2}	=	As specified in the standard flight procedure
Rate-of-Climb:	V_{t2}	=	As specified in the standard flight procedure

Given the above, computation of the remaining parameters is performed using an iterative procedure to arrive at the altitude increment, **DelH**. If the difference between **DelH** and **DelH**$_c$ (the computed altitude increment for the current iteration) is greater than one **ft**, **DelH** is set equal to **DelH**$_c$, and the iterative process is repeated until a difference of one **ft** or less is achieved.

Initial Assumed Altitude Increment:	DelH	=	250 ft

<u>Start of Iterative Loop</u>:

Final Segment Altitude MSL:	H_2	=	H_1 + DelH
Final Segment Temperature:	T_{c2}	=	$\{[T_{f,ap} - L(H_2)] - 32\}(5/9)$
Final True Speed:	V_{t2}	=	$V_{c2}/(SIGMA)^{1/2}$
Final Segment Thrust:	Th_2	=	$E + F(V_{c2}) + G_a(H_2) + G_b(H_2)^2 + H(T_{c2})$
Average Segment Thrust:	Th_{avg}	=	$0.5(Th_1 + Th_2)$
Average True Speed:	V_{tavg}	=	$0.5(V_{t1} + V_{t2})$

Average Segment
Altitude: H_{avg} = $H_1 + 0.5 DelH$

Average Airplane
Weight: W_{avg} = $W / \{ [THETA]^{[g/t\,(Rc)\,(t)]} \}$

Sine of the
Flight Angle: SIN_{ang} = $V_{t2} / (101.2686\,V_{tavg})$

Flight Angle: GAMMA = $\arcsin(SIN_{ang})$

Horizontal Segment
Distance: S_g =

$$S_g = \frac{0.042062\,(V_{t2}^2 - V_{t1}^2)}{[(N)(Th_{avg})/W_{avg}] - R_{avg} - SIN_{ang}}$$

Computed Altitude
Increment: $DelH_c$ = $S_g\,[\tan(GAMMA)]\,(1/0.95)$

Deviation of the
Computed Altitude
Increment from the
Altitude Increment
Assumed at the Start
of the Current
Iteration Cycle DEV = $abs[DelH_c - DelH]$

At this point the status of the iterative process is checked. If DEV is less than 1 ft, then the iterative process is complete. Otherwise,

Altitude
Increment: DelH = $DelH_c$

and the iterative process is repeated as above.

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R_{avg} is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

THRUST REDUCTION SEGMENT

A thrust reduction segment of 1000 ft (horizontal distance) is introduced to allow for a smooth transition of the thrust associated with the Federal Aviation Regulations, Part 36 thrust cutback point. This segment replaces the first 1000 ft of horizontal distance of the next segment which may be either a climb or an acceleration segment. Computation of the parameters associated with the thrust reduction segment and the next segment is performed simultaneously. For the thrust reduction segment the following apply:

Initial Calibrated
Airspeed: V_{c1} = V_{c2} of the previous segment

Initial Pressure
Altitude MSL: H_1 = H_2 of the previous segment

Initial Temperature: T_{c1} = T_{c2} of the previous segment

Average Segment Altitude: $H_{avg} = H_1 + 0.5DelH$

Average Airplane Weight: $W_{avg} = W / \{[THETA]^{(g/(R_c)(L))}\}$

Sine of the Flight Angle: $SIN_{ang} = V_{t2} / (101.2686 V_{tavg})$

Flight Angle: $GAMMA = \arcsin(SIN_{ang})$

Horizontal Segment Distance:

$$S_g = \frac{0.042062 (V_{t2}^2 - V_{t1}^2)}{[(N)(Th_{avg}) / W_{avg}] - R_{avg} - SIN_{ang}}$$

Computed Altitude Increment: $DelH_c = S_g [\tan(GAMMA)] (1/0.95)$

Deviation of the Computed Altitude Increment from the Altitude Increment Assumed at the Start of the Current Iteration Cycle: $DEV = \text{abs}[DelH_c - DelH]$

At this point the status of the iterative process is checked. If DEV is less than 1 ft, then the iterative process is complete. Otherwise,

Altitude Increment: $DelH = DelH_c$

and the iterative process is repeated as above.

where E, F, G_a, G_b, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R_{avg} is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

THRUST REDUCTION SEGMENT

A thrust reduction segment of **1000 ft** (horizontal distance) is introduced to allow for a smooth transition of the thrust associated with the Federal Aviation Regulations, Part **36** thrust cutback point. This segment replaces the first **1000 ft** of horizontal distance of the next segment which may be either a climb or an acceleration segment. Computation of the parameters associated with the thrust reduction segment and the next segment is performed simultaneously. For the thrust reduction segment the following apply:

Initial Calibrated Airspeed: $V_{c1} = V_{c2}$ of the previous segment

Initial Pressure Altitude MSL: $H_1 = H_2$ of the previous segment

Initial Temperature: $T_{c1} = T_{c2}$ of the previous segment

Average Segment Altitude: H_{avg} = $H_1 + 0.5DelH$

Average Airplane Weight: W_{avg} = $W_1 / \{ [THETA]^{[g/((Rc)(L))]} \}$

Sine of the Flight Angle: SIN_{ang} = $V_{t2} / (101.2686 V_{tavg})$

Flight Angle: GAMMA = $\arcsin(SIN_{ang})$

Horizontal Segment Distance: S_g =

$$S_g = \frac{0.042062\,(V_{t2}^2 - V_{t1}^2)}{[(N)(Th_{avg})/W_{avg}] - R_{avg} - SIN_{ang}}$$

Computed Altitude Increment: $DelH_c$ = $S_g\,[\tan(GAMMA)]\,(1/0.95)$

Deviation of the Computed Altitude Increment from the Altitude Increment Assumed at the Start of the Current Iteration Cycle DEV = $abs[DelH_c - DelH]$

At this point the status of the iterative process is checked. If DEV is less than 1 ft, then the iterative process is complete. Otherwise,

Altitude Increment: DelH = $DelH_c$

and the iterative process is repeated as above.

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R_{avg} is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

THRUST REDUCTION SEGMENT

A thrust reduction segment of 1000 ft (horizontal distance) is introduced to allow for a smooth transition of the thrust associated with the Federal Aviation Regulations, Part 36 thrust cutback point. This segment replaces the first 1000 ft of horizontal distance of the next segment which may be either a climb or an acceleration segment. Computation of the parameters associated with the thrust reduction segment and the next segment is performed simultaneously. For the thrust reduction segment the following apply:

Initial Calibrated Airspeed: V_{c1} = V_{c2} of the previous segment

Initial Pressure Altitude MSL: H_1 = H_2 of the previous segment

Initial Temperature: T_{c1} = T_{c2} of the previous segment

Non-Standard Temperature Ratio:	$THETA_{ns} =$	$SIGMA_{ns}^{(1/((g/(R_c(L)))-1))}$
Non-Standard Pressure Ratio:	$DELTA_{ns} =$	$THETA_{ns}^{(g/(R_c(L)))}$

GROUND ROLL SEGMENT

For the ground roll segment the following apply:

Airport Temperature:	T_{c1}	=	T_{c2}	=	$(T_{fap} - 32)(5/9)$
Pressure Altitude MSL:	H_1	=	H_2	=	H_{ap}
Initial Calibrated Airspeed:	V_{c1}	=	**16.0 kts**		

Given the above, the remaining parameters for the ground roll segment under non-standard conditions are computed as in Section **B.1**, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

CLIMB SEGMENT

The parameters for the climb segment under non-standard conditions are computed as in Section **B.1**, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

ACCELERATION SEGMENT

With the exception of the iterative process described below, the parameters for the acceleration segment under non-standard conditions are computed as in Section **B.1**, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

Computation of the remaining parameters is performed using an iterative procedure to arrive at the horizontal distance of the segment, S_{gns}. If the difference between S_{gns} and S_{gc} (the computed horizontal distance for the current iteration) is greater than ten ft, S_{gns} is set equal to the arithmetic average of S_{gns} and S_{gc}, and the iterative process is repeated until a difference of ten **ft** or less is achieved.

Initial Assumed Horizontal Distance:	S_{gns}	=	**S_g computed for standard conditions**

The equations for the acceleration segment under standard conditions are used to supplement the following non-standard computations:

<u>Start of Iterative Loop</u>:

Tangent of the Flight Angle:	$TAN_{ang} =$	**$0.95\,(DelH/S_{gns})$**

Sine of the
Flight Angle: $SIN\gamma_{ang} = \sin[\arctan(TAN\gamma_{ang})]$

Computed Horizontal
Distance:

$$S_{gc} = \frac{(1/2g)\,(0.95)\,(V_{t2}^2 - V_{t1}^2)}{[N(T_{h,avg})] - R_{avg} - SIN\gamma_{ang}}$$

Deviation of the
Computed Horizontal
Distance from the
Horizontal Distance
Assumed at the Start
of the Current
Iteration Cycle: $DEV = abs[S_{gc} - S_{gas}]$

At this point the status of the iterative process is checked. If DEV is less than ten ft, then the iterative process is complete. Otherwise,

Horizontal
Distance: $S_{gas} = 0.5[S_{gc} + S_{gas}]$

and the iterative process is repeated as above.

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R_{avg} is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

THRUST REDUCTION SEGMENT

The parameters for the thrust reduction segment under non-standard conditions are computed as in Section B.1, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

ERROR CHECKING

The non-standard portion of the profile generator maintains several built-in error checks which guard against the computation of improper takeoff profiles. Computation of takeoff profiles is not performed if any of the following conditions are detected:

(1) the computed flight angle for a climb segment is zero or negative;

(2) the computed horizontal distance for an acceleration segment is zero or negative;

(3) the number of iterations required to compute the horizontal distance of an acceleration segment exceeds five hundred; and

Sine of the
Flight Angle: $SIN_{ang} = \sin[\arctan(TAN_{ang})]$

Computed Horizontal
Distance:

$$S_{gc} = \frac{(1/2g)\,(0.95)\,(V_2^2 - V_1^2)}{[N(Th_{avg})] - R_{avg} - SIN_{ang}}$$

Deviation of the
Computed Horizontal
Distance from the
Horizontal Distance
Assumed at the Start
of the Current
Iteration Cycle: $DEV = abs[S_{gc} - S_{gas}]$

At this point the status of the iterative process is checked. If DEV is less than ten ft, then the iterative process is complete. Otherwise,

Horizontal
Distance: $S_{gas} = 0.5[S_{gc} + S_{gas}]$

and the iterative process is repeated as above.

where E, F, G_1, G_2, and H are engine-dependent coefficients from Data Base Number 11 for the thrust mode defined in the standard takeoff procedure; and

R_{avg} is a coefficient from Data Base Number 11 which is the non-dimensional ratio of the airplane's drag coefficient to lift coefficient for a given flap setting and airplane configuration. The landing gear is assumed to be retracted.

THRUST REDUCTION SEGMENT

The parameters for the thrust reduction segment under non-standard conditions are computed as in Section B.1, Standard Conditions, using the non-standard THETA, SIGMA, and DELTA, as appropriate.

ERROR CHECKING

The non-standard portion of the profile generator maintains several built-in error checks which guard against the computation of improper takeoff profiles. Computation of takeoff profiles is not performed if any of the following conditions are detected:

(1) the computed flight angle for a climb segment is zero or negative;

(2) the computed horizontal distance for an acceleration segment is zero or negative;

(3) the number of iterations required to compute the horizontal distance of an acceleration segment exceeds five hundred; and

TABLE B-1: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 0 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	4624	5004	5400	6352	7630	9173	10579
3	3719	4057	4501	5067	6644	6871	---
4	2616	2926	3240	3752	4503	5309	6699
5	3846	4157	4481	5257	6297	7545	8679
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	3279	3739	4160	4913	5992	7186	8080
10	2799	3128	3656	4424	5486	6037	---
11	2684	3034	3405	4006	4436	---	---
12	3000	3338	3879	4666	5754	6709	---
13	3705	4054	4607	5400	6483	7180	8167
14	3357	3684	4204	4956	5989	6660	7614
15	2693	3335	3959	---	---	---	---
16	3279	3739	4160	4913	5992	7186	8080
17	3705	4054	4607	5400	6483	7180	8167
18	6967	6967	8556	8556	9799	9799	---
19	3997	4389	4943	5838	6813	7868	---
20	3371	3656	3954	4609	5534	6575	7799
21	4669	5071	5463	6353	7614	9032	10657
22	5052	5383	5900	6443	7610	8883	---
23	4611	4897	5343	5811	6741	7747	8869
24	5968	6863	7821	8841	---	---	---
25	4513	5004	5522	6146	---	---	---
26	5460	6050	6913	8098	9476	---	---
27	5979	6964	8028	9074	---	---	---
28	4513	5004	5522	6146	---	---	---
29	5460	6050	6913	8098	9476	---	---
30	5263	6120	6965	7699	---	---	---
31	3352	3846	4285	5206	6369	---	---
32	3414	3703	4015	4587	5362	6268	6811
33	3020	3274	3549	4062	4765	5576	5970
34	3067	3467	3924	4411	5328	6299	---
35	3506	3981	4489	5506	---	---	---
36	3187	3681	4135	5041	---	---	---
37	4221	4827	5609	---	---	---	---
38	3292	4035	---	---	---	---	---
39	3184	3746	4612	---	---	---	---
40	3634	4416	5227	---	---	---	---
41	2124	2638	3133	---	---	---	---
42	3075	3310	3893	4618	---	---	---
43	3634	4416	5227	---	---	---	---
44	2124	2638	3133	---	---	---	---
45	3075	3310	3893	4618	---	---	---
46	3653	4186	4839	---	---	---	---
47	3303	3688	4096	4526	---	---	---
48	3897	4708	5601	---	---	---	---
49	3685	4155	4728	5991	---	---	---
50	4002	4548	5131	6493	---	---	---
51	2616	2816	3091	3573	4217	---	---
52	2747	2960	3219	3692	4376	5123	---
53	2826	---	---	---	---	---	---
54	2569	---	---	---	---	---	---
55	3689	---	---	---	---	---	---

TABLE B-1: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 0 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	4624	5004	5400	6352	7630	9173	10579
3	3719	4057	4501	5067	6644	6871	---
4	2616	2926	3240	3752	4503	5309	6699
5	3846	4157	4481	5257	6297	7545	8679
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	3279	3739	4160	4913	5992	7186	8080
10	2799	3128	3656	4424	5486	6037	---
11	2684	3034	3405	4006	4436	---	---
12	3000	3338	3879	4666	5754	6709	---
13	3705	4054	4607	5400	6483	7180	8167
14	3357	3684	4204	4956	5989	6660	7614
15	2693	3335	3959	---	---	---	---
16	3279	3739	4160	4913	5992	7186	8080
17	3705	4054	4607	5400	6483	7180	8167
18	6967	6967	8556	8556	9799	9799	---
19	3997	4389	4943	5838	6813	7868	---
20	3371	3656	3954	4609	5534	6575	7799
21	4669	5071	5463	6353	7614	9032	10657
22	5052	5383	5900	6443	7610	8883	---
23	4611	4897	5343	5811	6741	7747	8869
24	5968	6863	7821	8841	---	---	---
25	4513	5004	5522	6146	---	---	---
26	5460	6050	6913	8098	9476	---	---
27	5979	6964	8028	9074	---	---	---
28	4513	5004	5522	6146	---	---	---
29	5460	6050	6913	8098	9476	---	---
30	5263	6120	6965	7699	---	---	---
31	3352	3846	4285	5206	6369	---	---
32	3414	3703	4015	4587	5362	6268	6811
33	3020	3274	3549	4062	4765	5576	5970
34	3067	3467	3924	4411	5328	6299	---
35	3506	3981	4489	5506	---	---	---
36	3187	3681	4135	5041	---	---	---
37	4221	4827	5609	---	---	---	---
38	3292	4035	---	---	---	---	---
39	3184	3746	4612	---	---	---	---
40	3634	4416	5227	---	---	---	---
41	2124	2638	3133	---	---	---	---
42	3075	3310	3893	4618	---	---	---
43	3634	4416	5227	---	---	---	---
44	2124	2638	3133	---	---	---	---
45	3075	3310	3893	4618	---	---	---
46	3653	4186	4839	---	---	---	---
47	3303	3688	4096	4526	---	---	---
48	3897	4708	5601	---	---	---	---
49	3685	4155	4728	5991	---	---	---
50	4002	4548	5131	6193	---	---	---
51	2616	2816	3091	3573	4217	---	---
52	2747	2960	3219	3692	4376	5123	---
53	2826	---	---	---	---	---	---
54	2569	---	---	---	---	---	---
55	3689	---	---	---	---	---	---

TABLE B-2: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F , ELEVATION 0 FT MSL

INM #	STAGE WEIGHT 1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	4254	4603	4969	9843	7020	8139	9733
3	3422	3732	4141	4662	6112	6322	---
4	2406	2692	2981	3451	4142	4884	6163
5	3538	3824	4122	4837	5793	6942	7984
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	3017	3440	3827	4520	5512	6611	7434
10	2799	3128	3656	4424	5486	6037	---
11	2470	2791	3133	3686	4081	---	---
12	2760	3070	3569	4293	5294	6172	---
13	3409	3729	4238	4968	5964	6606	7514
14	3088	3389	3868	4559	5510	6127	7005
15	2478	3068	3642	---	---	---	---
16	3017	3440	3827	4520	5512	6611	7434
17	3409	3729	4238	4968	5964	6606	7514
18	6410	6410	7872	7872	9015	9015	---
19	3677	4038	4547	5371	6268	7239	---
20	3101	3364	3638	4240	5091	6049	7175
21	4295	4666	5025	5844	7005	8309	9804
22	4648	4952	5428	5928	7001	8172	---
23	4242	4505	4916	5346	6202	7127	8199
24	5968	6863	7821	8841	---	---	---
25	4152	4604	5080	9694	---	---	---
26	5023	5566	6360	7490	8718	---	---
27	5500	6407	7386	8347	---	---	---
28	4152	4604	5080	5654	---	---	---
29	5023	5566	6360	7490	8718	---	---
30	4942	5630	6408	7083	---	---	---
31	3084	1539	3942	4789	9860	---	---
32	3141	3407	3694	4220	4933	5767	6266
33	2778	3012	3265	3737	4384	5130	5492
34	2822	3389	3610	4058	4902	5795	---
35	3226	3663	4130	5065	---	---	---
36	2928	3382	3799	4631	---	---	---
37	3883	4410	9160	---	---	---	---
38	3029	3712	---	---	---	---	---
39	2930	3146	4243	---	---	---	---
40	3343	4062	4809	---	---	---	---
41	1954	2427	2883	---	---	---	---
42	2829	3045	3581	4249	---	---	---
43	3343	4062	4809	---	---	---	---
44	1954	2427	2883	---	---	---	---
45	2829	3045	3561	4219	---	---	---
46	3361	3851	4452	---	---	---	---
47	,039	3393	3768	4164	---	---	---
48	3585	4332	5153	---	---	---	---
49	3390	3822	4349	9512	---	---	---
50	3681	4181	4720	5971	---	---	---
51	2434	2619	2813	3287	3879	---	---
52	2926	2722	2961	3395	4024	4712	---
53	2600	---	---	---	---	---	---
54	2364	---	---	---	---	---	---
55	3394	---	---	---	---	---	---

TABLE B-2: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F , ELEVATION 0 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	4254	4603	4969	9843	7020	8139	9733
3	3422	3732	4141	4662	6112	6372	---
4	2406	2692	2981	3451	4142	4884	6163
5	3538	3824	4122	4837	5793	6942	7984
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	3017	3440	3827	4520	5512	6611	7434
10	2799	3128	3656	4424	5486	6037	---
11	2470	2791	3133	3686	4081	---	---
12	2760	3070	3569	4293	5294	6172	---
13	3409	3729	4238	4968	5964	6606	7514
14	3088	3389	3868	4559	5510	6127	7005
15	2478	3068	3642	---	---	---	---
16	3017	3440	3827	4520	5512	6611	7434
17	3409	3729	4238	4968	5964	6606	7514
18	6410	6410	7872	7872	9015	9015	---
19	3677	4038	4547	5371	6268	7239	---
20	3101	3364	3638	4240	5091	6049	7175
21	4295	4666	5026	5844	7005	8309	9804
22	4648	4952	5428	5928	7001	8172	---
23	4242	4505	4916	5346	6202	7127	8159
24	5968	6863	7821	8841	---	---	---
25	4152	4604	5080	[illegible]	---	---	---
26	5023	5566	6360	7450	8718	---	---
27	5500	6407	7386	8347	---	---	---
28	4152	4604	5080	5654	---	---	---
29	5023	5566	6360	7450	8718	---	---
30	4842	5630	6408	7083	---	---	---
31	3084	1539	3942	4789	9860	---	---
32	3141	3407	3694	4220	4933	5767	6266
33	2778	3012	3265	3737	4184	5130	5492
34	2822	3189	3610	4058	4902	5795	---
35	3226	3663	4130	9065	---	---	---
36	2928	3382	3799	4631	---	---	---
37	3883	[illegible]	9160	---	---	---	---
38	3029	3712	---	---	---	---	---
39	2930	3146	4213	---	---	---	---
40	3343	4062	4809	---	---	---	---
41	1954	2427	2883	---	---	---	---
42	2829	3045	3581	4249	---	---	---
43	3343	4062	4809	---	---	---	---
44	1954	2427	2883	---	---	---	---
45	2829	3045	3581	4219	---	---	---
46	3361	3851	4452	---	---	---	---
47	,039	3393	3768	4164	---	---	---
48	3585	4332	5153	---	---	---	---
49	3390	3822	4349	9512	---	---	---
50	3681	4183	4720	5971	---	---	---
51	2434	2619	2843	3287	3879	---	---
52	2926	2722	2961	3395	4024	4712	---
53	2600	---	---	---	---	---	---
54	2364	---	---	---	---	---	---
55	3394	---	---	---	---	---	---

TABLE B-3: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 0 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7789	---
2	5053	5468	5901	6941	9338	10024	11561
3	4064	4433	4919	9937	7260	7509	---
4	2858	3198	3541	4100	4920	5801	7321
5	4202	4542	4896	5745	6881	8245	9484
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	3583	4086	4545	5369	6548	7852	8830
10	2799	3128	3656	4424	5486	6037	---
11	2933	3315	3721	4378	4847	---	---
12	3278	3647	4239	5099	6289	7332	---
13	4049	4430	5034	5901	7084	7846	8925
15	2943	3644	4326	5415	6544	7277	8320
16	3583	4086	4545	5369	6548	7852	8830
17	4049	4430	5034	5901	7084	7846	8925
18	7614	7614	9350	9350	10708	10708	---
19	4368	4797	5401	6380	7445	8598	---
20	3683	3995	4321	5037	6047	7185	8523
21	9102	5542	9970	6942	8321	9870	11646
22	5521	9882	6447	7041	8315	9707	---
23	5039	5391	5639	6350	7366	8465	9692
24	5968	6863	7821	8841	---	---	---
25	4932	5468	6034	6716	---	---	---
26	5967	6612	7554	8849	10359	---	---
27	6533	7610	8773	9915	---	---	---
28	4932	5468	6034	6716	---	---	---
29	9967	6612	7554	8849	10395	---	---
30	5751	6688	7611	8413	---	---	---
31	3663	4203	4693	5689	6960	---	---
32	3731	4047	4387	5012	5860	6850	7443
33	3300	3978	3878	4439	5207	6094	6524
34	3392	3788	4287	4820	5823	6883	---
35	3832	4351	4905	6016	---	---	---
36	3488	4029	4526	5516	---	---	---
37	4613	5274	6129	---	---	---	---
38	3598	4409	---	---	---	---	---
39	3480	4093	5040	---	---	---	---
40	3971	4825	5712	---	---	---	---
41	2321	2883	3424	---	---	---	---
42	3361	3617	4254	9047	---	---	---
43	3971	4825	5712	---	---	---	---
44	2321	2883	3424	---	---	---	---
45	3361	3617	4254	9047	---	---	---
46	3992	4574	5288	---	---	---	---
47	3609	4030	4476	4946	---	---	---
48	4258	9145	6121	---	---	---	---
49	4027	4540	5166	6547	---	---	---
50	4373	4970	5607	7095	---	---	---
51	2891	3111	3377	3904	4608	---	---
52	3002	3236	3519	4036	4783	5600	---
53	3088	---	---	---	---	---	---
54	2808	---	---	---	---	---	---
55	4031	---	---	---	---	---	---

TABLE B-3: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F, ELEVATION 0 FT MSL (CONTINUED)

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	3421	---	---	---	---	---	---
58	3823	---	---	---	---	---	---
59	4071	---	---	---	---	---	---
60	3246	---	---	---	---	---	---
61	5404	---	---	---	---	---	---
62	4260	---	---	---	---	---	---
63	3006	3787	5111	---	---	---	---
64	1961	---	---	---	---	---	---
65	1150	---	---	---	---	---	---
66	4302	5485	6556	---	---	---	---
67	2941	---	---	---	---	---	---
68	2853	---	---	---	---	---	---
69	1361	---	---	---	---	---	---
70	3546	4683	6014	---	---	---	---
71	1694	2069	0	---	---	---	---
72	1997	2599	---	---	---	---	---
73	2321	---	---	---	---	---	---
74	704	---	---	---	---	---	---
75	823	---	---	---	---	---	---
76	1766	---	---	---	---	---	---
77	780	---	---	---	---	---	---
78	11509	---	---	---	---	---	---
79	4538	7077	---	---	---	---	---
80	5637	7720	---	---	---	---	---
81	6022	7504	---	---	---	---	---
82	5707	8526	---	---	---	---	---
83	4116	4582	4973	5806	6946	8590	9984
84	4463	4831	5197	6109	7334	8799	10152
85	3996	4646	5169	6304	---	---	---
86	3901	4508	5066	6182	---	---	---
87	3009	3262	3537	4052	4754	5569	5963
88	3215	3943	4754	---	---	---	---
89	3633	4464	5268	---	---	---	---
90	3483	4255	5112	---	---	---	---
91	12306	---	---	---	---	---	---
92	10171	---	---	---	---	---	---
93	3544	3929	4493	5267	6169	---	---
94	3283	3640	4017	4472	---	---	---
95	3346	---	---	---	---	---	---
96	4579	---	---	---	---	---	---
97	3978	4733	5637	6539	---	---	---
98	4520	---	---	---	---	---	---
99	2652	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	4777	5163	5964	6563	7651	9004	10667
103	5189	5613	6055	7156	8358	9858	11708
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-3: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 0 FT MSL (CONTINUED)

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	3421	---	---	---	---	---	---
58	3823	---	---	---	---	---	---
59	4071	---	---	---	---	---	---
60	3246	---	---	---	---	---	---
61	5404	---	---	---	---	---	---
62	4260	---	---	---	---	---	---
63	3006	3787	5111	---	---	---	---
64	1961	---	---	---	---	---	---
65	1850	---	---	---	---	---	---
66	4302	5485	6558	---	---	---	---
67	2941	---	---	---	---	---	---
68	2853	---	---	---	---	---	---
69	1381	---	---	---	---	---	---
70	3546	4683	6014	---	---	---	---
71	1694	2069	0	---	---	---	---
72	1997	2599	---	---	---	---	---
73	2321	---	---	---	---	---	---
74	704	---	---	---	---	---	---
75	823	---	---	---	---	---	---
76	1766	---	---	---	---	---	---
77	780	---	---	---	---	---	---
78	11509	---	---	---	---	---	---
79	4538	7077	---	---	---	---	---
80	5637	7720	---	---	---	---	---
81	6022	7504	---	---	---	---	---
82	5707	8526	---	---	---	---	---
83	4116	4582	4973	5806	6916	8590	9984
84	4463	4831	5197	6109	7334	8793	10152
85	3996	4646	5169	6304	---	---	---
86	3901	4508	5066	6182	---	---	---
87	3009	3262	3537	4052	4754	5569	5963
88	3215	3943	4754	---	---	---	---
89	3633	4464	5268	---	---	---	---
90	3483	4255	5112	---	---	---	---
91	12306	---	---	---	---	---	---
92	10171	---	---	---	---	---	---
93	3544	3929	4493	5267	6169	---	---
94	3283	3640	4017	4472	---	---	---
95	3346	---	---	---	---	---	---
96	4579	---	---	---	---	---	---
97	3978	4733	5637	6539	---	---	---
98	4520	---	---	---	---	---	---
99	2652	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	4777	5163	5564	6563	7651	9004	20667
103	5189	5613	6055	7156	8358	9858	11708
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-4: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 3000 FT MSL (CONTINUED)

mM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	3647	---	---	---	---	---	---
58	4240	---	---	---	---	---	---
59	4790	---	---	---	---	---	---
60	3458	---	---	---	---	---	---
61	5994	---	---	---	---	---	---
62	4798	---	---	---	---	---	---
63	3261	4108	5545	---	---	---	---
64	2156	---	---	---	---	---	---
65	1464	---	---	---	---	---	---
66	4667	5951	7115	---	---	---	---
67	3191	---	---	---	---	---	---
68	3095	---	---	---	---	---	---
69	1499	---	---	---	---	---	---
70	3947	5081	6525	---	---	---	---
71	1838	2245	0	---	---	---	---
72	2167	2820	---	---	---	---	---
73	2518	---	---	---	---	---	---
74	764	---	---	---	---	---	---
75	493	---	---	---	---	---	---
76	1916	---	---	---	---	---	---
77	846	---	---	---	---	---	---
78	13454	---	---	---	---	---	---
79	5094	7944	---	---	---	---	---
80	6328	8665	---	---	---	---	---
81	5448	8141	---	---	---	---	---
82	6192	9252	---	---	---	---	---
83	4637	5160	5599	6535	7015	9662	11228
84	6043	5459	5872	6900	8281	9932	11457
85	4503	5235	5823	7099	---	---	---
86	4233	4890	5494	6698	---	---	---
87	3464	3755	4071	4664	5471	6408	6861
88	3717	0	0	---	---	---	---
89	3949	4849	5718	---	---	---	---
90	4008	4896	5881	---	---	---	---
91	13820	---	---	---	---	---	---
92	11445	---	---	---	---	---	---
93	4029	4466	5106	5985	7009	---	---
94	3900	4214	4650	5176	---	---	---
95	3660	---	---	---	---	---	---
96	5268	---	---	---	---	---	---
97	4698	5591	6659	7725	---	---	---
98	5066	---	---	---	---	---	---
99	2913	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	4968	5367	5783	6816	7939	9335	11051
103	5183	5603	6041	7111	8318	9796	11616
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-4: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F , ELEVATION 3000 FT MSL (CONTINUED)

RUN #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	3647	---	---	---	---	---	---
58	4210	---	---	---	---	---	---
59	4790	---	---	---	---	---	---
60	3458	---	---	---	---	---	---
61	5994	---	---	---	---	---	---
62	4793	---	---	---	---	---	---
63	3261	4108	9545	---	---	---	---
64	2156	---	---	---	---	---	---
65	1461	---	---	---	---	---	---
66	4667	9991	7135	---	---	---	---
67	3191	---	---	---	---	---	---
68	3095	---	---	---	---	---	---
69	3499	---	---	---	---	---	---
70	3947	9081	6525	---	---	---	---
71	3838	2245	0	---	---	---	---
72	2167	2820	---	---	---	---	---
73	2939	---	---	---	---	---	---
74	764	---	---	---	---	---	---
75	993	---	---	---	---	---	---
76	1916	---	---	---	---	---	---
77	846	---	---	---	---	---	---
78	13151	---	---	---	---	---	---
79	5094	7944	---	---	---	---	---
80	6328	8665	---	---	---	---	---
81	9448	8143	---	---	---	---	---
82	6392	9252	---	---	---	---	---
83	4637	5160	9599	6935	7919	9662	11228
84	5043	5459	5872	6900	8281	9932	11457
85	4503	5235	9823	7099	---	---	---
86	4233	4890	9494	6698	---	---	---
87	3464	3755	4071	4664	5471	6408	6861
88	3717	0	0	---	---	---	---
89	3949	4849	5718	---	---	---	---
90	4008	4896	5881	---	---	---	---
91	13820	---	---	---	---	---	---
92	11445	---	---	---	---	---	---
93	4029	4166	5106	9905	7009	---	---
94	3900	4211	4690	9376	---	---	---
95	3660	---	---	---	---	---	---
96	5768	---	---	---	---	---	---
97	4698	5591	6659	7725	---	---	---
98	5066	---	---	---	---	---	---
99	2913	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	4968	5367	5783	6816	7939	9335	11051
103	5183	5603	6041	7131	8318	9796	11616
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-5: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F , ELEVATION 3000 FT MSL (CONTINUED)

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	3355	---	---	---	---	---	---
58	3901	---	---	---	---	---	---
59	4407	---	---	---	---	---	---
60	3181	---	---	---	---	---	---
61	5514	---	---	---	---	---	---
62	4414	---	---	---	---	---	---
63	2945	3710	5007	---	---	---	---
64	1903	---	---	---	---	---	---
65	1322	---	---	---	---	---	---
66	4214	5373	6124	---	---	---	---
67	2881	---	---	---	---	---	---
68	2795	---	---	---	---	---	---
69	1353	---	---	---	---	---	---
70	3474	4588	5892	---	---	---	---
71	1660	2027	0	---	---	---	---
72	1957	2546	---	---	---	---	---
73	2274	---	---	---	---	---	---
74	690	---	---	---	---	---	---
75	806	---	---	---	---	---	---
76	1730	---	---	---	---	---	---
77	764	---	---	---	---	---	---
78	12377	---	---	---	---	---	---
79	4686	7308	---	---	---	---	---
80	5822	7972	---	---	---	---	---
81	4920	7351	---	---	---	---	---
82	5591	8354	---	---	---	---	---
83	4266	4747	5151	6032	7189	8889	10329
84	4639	5022	5402	6348	7618	9137	10540
85	4343	4816	5357	6533	---	---	---
86	3895	4499	5054	6162	---	---	---
87	3186	3455	3745	4290	5033	5895	6312
88	3420	4193	0	---	---	---	---
89	3633	4161	5263	---	---	---	---
90	3687	4505	5413	---	---	---	---
91	12695	---	---	---	---	---	---
92	10529	---	---	---	---	---	---
93	3706	4108	4697	5506	6449	---	---
94	3496	3877	4279	4762	---	---	---
95	3367	---	---	---	---	---	---
96	4816	---	---	---	---	---	---
97	4322	5143	6126	7107	---	---	---
98	4661	---	---	---	---	---	---
99	2680	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	4221	4563	4915	5790	6712	7923	9374
103	4333	4683	5047	5953	6939	8166	9675
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-6: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 3000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6283	6799	7336	8628	10362	12453	14358
3	5056	5514	6117	6885	9023	9332	---
4	3557	3979	4405	5100	6120	7213	9099
5	5126	5540	5971	7003	8385	10044	11549
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4402	5020	5583	6592	8037	9636	10833
10	2799	3128	3656	4424	5486	6037	---
11	3637	4110	4613	5426	6007	---	---
12	4205	4678	5438	6541	8066	9405	---
13	5189	5677	6452	7563	9079	10056	11438
14	4519	4958	5658	6667	8055	8955	10236
15	3718	0	0	---	---	---	---
16	4402	5020	5583	6592	8037	9636	10833
17	5189	5677	6452	7563	9079	10056	11438
18	9489	9489	11650	11650	13340	13340	---
19	5638	6192	6973	8237	9613	11102	---
20	4513	4895	5293	6168	7403	8794	10428
21	6558	7123	7673	8924	10696	12688	14971
22	6846	7293	7993	8728	10304	12025	---
23	6277	6665	7272	7908	9171	10537	12062
24	5968	6863	7821	8841	---	---	---
25	6363	7056	7785	8666	---	---	---
26	7382	8179	9344	10944	12805	---	---
27	8377	9758	11249	12713	---	---	---
28	6363	7056	7785	8666	---	---	---
29	7382	8179	9344	10944	12805	---	---
30	7126	8286	9429	10422	---	---	---
31	4725	5422	6041	7339	8980	---	---
32	4585	4973	5390	6157	7196	8409	9136
33	3940	4272	4629	5297	6211	7265	7777
34	3939	4450	5034	5657	6829	8068	---
35	4545	5159	5814	7125	---	---	---
36	4297	4962	5573	6792	---	---	---
37	5931	6782	7881	---	---	---	---
38	4160	5464	---	---	---	---	---
39	4333	5096	6274	---	---	---	---
40	5082	6176	7311	---	---	---	---
41	2964	3681	4372	---	---	---	---
42	4324	4654	5473	6494	---	---	---
43	5082	6176	7311	---	---	---	---
44	2964	3681	4372	---	---	---	---
45	4324	4654	5473	6494	---	---	---
46	5108	5852	6766	---	---	---	---
47	4473	4995	5547	6129	---	---	---
48	5240	6330	7528	---	---	---	---
49	4970	5603	6375	8076	---	---	---
50	5495	6245	7045	8914	---	---	---
51	3561	3831	4159	4807	5672	---	---
52	3593	3871	4210	4825	5716	6689	---
53	3690	---	---	---	---	---	---
54	3586	---	---	---	---	---	---
55	5212	---	---	---	---	---	---

TABLE B-6: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F, ELEVATION 3000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6283	6799	7336	8628	10362	12453	14358
3	5056	5511	6117	6885	9023	9332	---
4	3557	3979	4405	5100	6120	7213	9099
5	5126	5540	5971	7003	8385	10044	11549
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4402	5020	5583	6592	8037	9636	10833
10	2799	3128	3656	4424	5486	6037	---
11	3637	4110	4613	5426	6007	---	---
12	4205	4678	5438	6541	8066	9405	---
13	5189	5677	6452	7563	9079	10056	11438
14	4519	4958	5658	6667	8055	8955	10236
15	3718	0	0	---	---	---	---
16	4402	5020	5583	6592	8037	9636	10833
17	5189	5677	6452	7563	9079	10056	11438
18	9489	9489	11650	11650	13340	13340	---
19	5638	6192	6973	8237	9613	11102	---
20	4513	4895	5293	6168	7403	8794	10428
21	6558	7123	7673	8924	10696	12688	14971
22	6846	7293	7993	8728	10304	12025	---
23	6277	6665	7272	7908	9171	10537	12062
24	5968	6863	7821	8841	---	---	---
25	6363	7056	7785	8666	---	---	---
26	7382	8179	9344	10944	12805	---	---
27	8377	9758	11249	12713	---	---	---
28	6363	7056	7785	8666	---	---	---
29	7382	8179	9344	10944	12805	---	---
30	7126	8286	9429	10422	---	---	---
31	4725	5422	6041	7339	8980	---	---
32	4585	4973	5390	6157	7196	8409	9136
33	3940	4272	4629	5297	6211	7265	7777
34	3939	4450	5034	5657	6829	8068	---
35	4545	5159	5814	7125	---	---	---
36	4297	4962	5573	6792	---	---	---
37	5931	6782	7881	---	---	---	---
38	4160	5464	---	---	---	---	---
39	4333	5096	6274	---	---	---	---
40	5082	6176	7311	---	---	---	---
41	2964	3681	4372	---	---	---	---
42	4324	4654	5473	6494	---	---	---
43	5082	6176	7311	---	---	---	---
44	2964	3681	4372	---	---	---	---
45	4324	4654	5473	6494	---	---	---
46	5108	5852	6766	---	---	---	---
47	4473	4995	5547	6129	---	---	---
48	5240	6330	7528	---	---	---	---
49	4970	5603	6375	8076	---	---	---
50	5495	6245	7045	8914	---	---	---
51	3561	3831	4159	4807	5672	---	---
52	3593	3871	4210	4825	5716	6689	---
53	3690	---	---	---	---	---	---
54	3586	---	---	---	---	---	---
55	5212	---	---	---	---	---	---

TABLE B-6: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 3000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6283	6799	7336	8628	10362	12453	14358
3	5056	5511	6117	6885	9023	9332	---
4	3557	3979	4405	5100	6120	7213	9099
5	5126	5540	5971	7003	8385	10044	11549
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4402	5020	5583	6592	8037	9636	10833
10	2799	3128	3656	4424	5486	6037	---
11	3637	4110	4613	5426	6007	---	---
12	4205	4678	5438	6541	8066	9405	---
13	5189	5677	6452	7563	9079	10056	11438
14	4519	4958	5658	6667	8055	8955	10236
15	3718	0	0	---	---	---	---
16	4402	5020	5583	6592	8037	9636	10833
17	5189	5677	6452	7563	9079	10056	11438
18	9489	9489	11650	11650	13340	13340	---
19	5638	6192	6973	8237	9613	11102	---
20	4513	4895	5293	6168	7403	8794	10428
21	6558	7123	7673	8924	10696	12688	14971
22	6846	7293	7993	8728	10304	12025	---
23	6277	6665	7272	7908	9171	10537	12062
24	5968	6863	7821	8841	---	---	---
25	6363	7056	7785	8666	---	---	---
26	7382	8179	9344	10944	12805	---	---
27	8377	9758	11249	12713	---	---	---
28	6363	7056	7785	8666	---	---	---
29	7382	8179	9344	10944	12805	---	---
30	7126	8286	9429	10422	---	---	---
31	4725	5422	6041	7339	8980	---	---
32	4585	4973	5390	6157	7196	8409	9136
33	3940	4272	4629	5297	6211	7265	7777
34	3939	4450	5034	5657	6829	8068	---
35	4545	5159	5814	7125	---	---	---
36	4297	4962	5573	6792	---	---	---
37	5931	6782	7881	---	---	---	---
38	4160	5464	---	---	---	---	---
39	4333	5096	6274	---	---	---	---
40	5082	6176	7311	---	---	---	---
41	2964	3681	4372	---	---	---	---
42	4324	4654	5473	6494	---	---	---
43	5082	6176	7311	---	---	---	---
44	2964	3681	4372	---	---	---	---
45	4324	4654	5473	6494	---	---	---
46	5108	5852	6766	---	---	---	---
47	4473	4995	5547	6129	---	---	---
48	5240	6330	7528	---	---	---	---
49	4970	5603	6375	8076	---	---	---
50	5495	6245	7045	8914	---	---	---
51	3561	3831	4159	4807	5672	---	---
52	3593	3871	4210	4825	5716	6689	---
53	3690	---	---	---	---	---	---
54	3586	---	---	---	---	---	---
55	5212	---	---	---	---	---	---

TABLE B-7: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 59°F, ELEVATION 6000 FT MSL (CONTINUED)

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	4399	---	---	---	---	---	---
58	5180	---	---	---	---	---	---
59	6192	---	---	---	---	---	---
60	4168	---	---	---	---	---	---
61	7322	---	---	---	---	---	---
62	6054	---	---	---	---	---	---
63	3960	4989	6733	---	---	---	---
64	2613	---	---	---	---	---	---
65	1778	---	---	---	---	---	---
66	5667	7225	8639	---	---	---	---
67	3874	---	---	---	---	---	---
68	3758	---	---	---	---	---	---
69	1820	---	---	---	---	---	---
70	4672	6169	7923	---	---	---	---
71	2232	2726	0	---	---	---	---
72	2631	3424	---	---	---	---	---
73	3057	---	---	---	---	---	---
74	928	---	---	---	---	---	---
75	1084	---	---	---	---	---	---
76	2327	---	---	---	---	---	---
77	1027	---	---	---	---	---	---
78	17276	---	---	---	---	---	---
79	6260	9762	---	---	---	---	---
80	7779	10648	---	---	---	---	---
81	6616	9885	---	---	---	---	---
82	7519	11234	---	---	---	---	---
83	5744	6391	6934	8092	9673	11956	13889
84	6267	6783	7296	8571	10283	12329	14218
85	5582	6488	7215	8794	---	---	---
86	5073	5858	6578	8016	---	---	---
87	4381	4749	5148	5897	6918	8101	8674
88	0	0	0	---	---	---	---
89	4739	5815	6854	---	---	---	---
90	5068	6190	7434	---	---	---	---
91	17102	---	---	---	---	---	---
92	14072	---	---	---	---	---	---
93	5034	5580	6378	7475	8753	---	---
94	4833	5359	5913	6582	---	---	---
95	4448	---	---	---	---	---	---
96	6659	---	---	---	---	---	---
97	6095	7253	8639	10023	---	---	---
98	6323	---	---	---	---	---	---
99	3528	---	---	---	---	---	---
100	4513	5004	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	6256	6758	7281	8581	9994	11750	13906
103	6435	6955	7498	8848	10319	12149	14402
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

TABLE B-8: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F, ELEVATION 6000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6652	7197	7766	9131	10964	13173	15186
3	5354	5838	6476	7288	9549	9876	---
4	3768	4215	4666	5400	6479	7636	9630
5	5302	5729	6174	7240	8665	10376	11928
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4553	5190	5772	6813	8304	9952	11187
10	2799	3128	3656	4424	5486	6037	---
11	3811	4305	4832	5682	6290	---	---
12	4564	5078	5902	7100	8756	10210	---
13	5627	6157	6997	8202	9846	10906	12405
14	4718	5175	5904	6956	8401	9338	10671
15	0	0	0	---	---	---	---
16	4553	5190	5772	6813	8304	9952	11187
17	5627	6157	6997	8202	9846	10906	12405
18	10014	10014	12293	12293	14074	14074	---
19	6158	6763	7616	8997	10501	12129	---
20	4687	5083	5496	6404	7684	9124	10817
21	7132	7748	8346	9706	11634	13801	16285
22	7182	7650	8383	9152	10801	12602	---
23	6614	7023	7661	8330	9659	11096	12698
24	5968	6863	7821	8841	---	---	---
25	6885	7634	8423	9376	---	---	---
26	8030	8898	10165	11906	13930	---	---
27	9155	10665	12295	13896	---	---	---
28	6885	7634	8423	9376	---	---	---
29	8030	8898	10165	11906	13930	---	---
30	7749	9011	10254	11334	---	---	---
31	5157	5917	6594	8011	9803	---	---
32	4775	5178	5613	6409	7489	8749	9504
33	3999	4335	4697	5373	6297	7364	7881
34	3982	4497	5086	5714	6894	8140	---
35	4586	5203	5862	7179	---	---	---
36	4472	5163	5798	7064	---	---	---
37	6455	7381	8577	---	---	---	---
38	4682	5736	---	---	---	---	---
39	4569	5373	6613	---	---	---	---
40	5504	6689	7918	---	---	---	---
41	3202	3977	4721	---	---	---	---
42	4712	5071	5964	7077	---	---	---
43	5504	6689	7918	---	---	---	---
44	3202	3977	4721	---	---	---	---
45	4712	5071	5964	7077	---	---	---
46	5530	6336	7325	---	---	---	---
47	4864	5432	6032	6665	---	---	---
48	5464	6599	7846	---	---	---	---
49	5198	5859	6665	8442	---	---	---
50	5845	6643	7493	9480	---	---	---
51	3717	3998	4340	5015	5917	---	---
52	3651	3933	4276	4900	5802	6786	---
53	3775	---	---	---	---	---	---
54	3838	---	---	---	---	---	---
55	5616	---	---	---	---	---	---

TABLE B-8: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F , ELEVATION 6000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6652	7197	7766	9131	10964	13173	15186
3	5354	5838	6476	7288	9549	9876	---
4	3768	4215	4666	5400	6479	7636	9630
5	5302	5729	6174	7240	8665	10376	11928
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4553	5190	5772	6813	8304	9952	11187
10	2799	3128	3656	4424	5486	6037	---
11	3811	4305	4832	5682	6290	---	---
12	4564	5078	5902	7100	8756	10210	---
13	5627	6157	6997	8202	9846	10906	12405
14	4718	5175	5904	6956	8401	9338	10671
15	0	0	0	---	---	---	---
16	4553	5190	5772	6813	8304	9952	11187
17	5627	6157	6997	8202	9846	10906	12405
18	10014	10014	12293	12293	14074	14074	---
19	6158	6763	7616	8997	10501	12129	---
20	4687	5083	5496	6404	7684	9124	10817
21	7132	7748	8346	9706	11634	13801	16285
22	7182	7650	8383	9152	10801	12602	---
23	6614	7023	7661	8330	9659	11096	12698
24	5968	6863	7821	8841	---	---	---
25	6885	7634	8423	9376	---	---	---
26	8030	8898	10165	11906	13930	---	---
27	9155	10665	12295	13896	---	---	---
28	6885	7634	8423	9376	---	---	---
29	8030	8898	10165	11906	13930	---	---
30	7749	9011	10254	11334	---	---	---
31	5157	5917	6594	8011	9803	---	---
32	4775	5178	5613	6409	7489	8749	9504
33	3999	4335	4697	5373	6297	7364	7881
34	3982	4497	5086	5714	6894	8140	---
35	4586	5203	5862	7179	---	---	---
36	4472	5163	5798	7064	---	---	---
37	6455	7381	8577	---	---	---	---
38	4682	5736	---	---	---	---	---
39	4569	5373	6613	---	---	---	---
40	5501	6689	7918	---	---	---	---
41	3202	3977	4721	---	---	---	---
42	4712	5071	5964	7077	---	---	---
43	5504	6689	7918	---	---	---	---
44	3202	3977	4721	---	---	---	---
45	4712	5071	5964	7077	---	---	---
46	5530	6336	7325	---	---	---	---
47	4864	5432	6032	6665	---	---	---
48	5464	6599	7846	---	---	---	---
49	5198	5859	6665	8442	---	---	---
50	5845	6643	7493	9480	---	---	---
51	3717	3998	4340	5015	5917	---	---
52	3651	3933	4276	4900	5802	6786	---
53	3775	---	---	---	---	---	---
54	3838	---	---	---	---	---	---
55	5616	---	---	---	---	---	---

TABLE B-8: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 40°F , ELEVATION 6000 FT MSL

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
1	4358	4732	5223	5842	7545	7788	---
2	6652	7197	7766	9131	10964	13173	15186
3	5354	5838	6476	7288	9549	9876	---
4	3768	4215	4666	5400	6479	7636	9630
5	5302	5729	6174	7240	8665	10376	11928
6	4193	4671	5438	6551	8098	9433	---
7	3963	4429	5176	6263	7767	8547	---
8	2721	3109	3523	4193	4671	---	---
9	4553	5190	5772	6813	8304	9952	11187
10	2799	3128	3656	4424	5486	6037	---
11	3811	4305	4832	5682	6290	---	---
12	4564	5078	5902	7100	8756	10210	---
13	5627	6157	6997	8202	9846	10906	12405
14	4718	5175	5904	6956	8401	9338	10671
15	0	0	0	---	---	---	---
16	4553	5190	5772	6813	8304	9952	11187
17	5627	6157	6997	8202	9846	10906	12405
18	10014	10014	12293	12293	14074	14074	---
19	6158	6763	7616	8997	10501	12129	---
20	4687	5083	5496	6404	7684	9124	10817
21	7132	7748	8346	9706	11634	13801	16285
22	7182	7650	8383	9152	10801	12602	---
23	6614	7023	7661	8330	9659	11096	12698
24	5968	6863	7821	8841	---	---	---
25	6885	7634	8423	9376	---	---	---
26	8030	8898	10165	11906	13930	---	---
27	9155	10665	12295	13896	---	---	---
28	6885	7634	8423	9376	---	---	---
29	8030	8898	10165	11906	13930	---	---
30	7749	9011	10254	11334	---	---	---
31	5157	5917	6594	8011	9803	---	---
32	4775	5178	5613	6409	7489	8749	9504
33	3999	4335	4697	5373	6297	7364	7881
34	3982	4497	5086	5714	6894	8140	---
35	4586	5203	5862	7179	---	---	---
36	4472	5163	5798	7064	---	---	---
37	6455	7381	8577	---	---	---	---
38	4682	5736	---	---	---	---	---
39	4569	5373	6613	---	---	---	---
40	5501	6689	7918	---	---	---	---
41	3202	3977	4721	---	---	---	---
42	4712	5071	5964	7077	---	---	---
43	5504	6689	7918	---	---	---	---
44	3202	3977	4721	---	---	---	---
45	4712	5071	5964	7077	---	---	---
46	5530	6336	7325	---	---	---	---
47	4864	5432	6032	6665	---	---	---
48	5464	6599	7846	---	---	---	---
49	5198	5859	6665	8442	---	---	---
50	5845	6643	7493	9480	---	---	---
51	3717	3998	4340	5015	5917	---	---
52	3651	3933	4276	4900	5802	6786	---
53	3775	---	---	---	---	---	---
54	[illegible]	---	---	---	---	---	---
55	5616	---	---	---	---	---	---

TABLE B-9: RUNWAY REQUIREMENTS/OPERATIONAL BOUNDARIES OF THE PROFILE GENERATOR, TEMPERATURE 80°F , ELEVATION 6000 FT MSL (CONTINUED)

INM #	STAGE WEIGHT						
	1	2	3	4	5	6	7
56	4136	---	---	---	---	---	---
57	4807	---	---	---	---	---	---
58	5661	---	---	---	---	---	---
59	6766	---	---	---	---	---	---
60	4555	---	---	---	---	---	---
61	9001	---	---	---	---	---	---
62	6615	---	---	---	---	---	---
63	4414	5561	7505	---	---	---	---
64	2855	---	---	---	---	---	---
65	1982	---	---	---	---	---	---
66	6317	8054	9629	---	---	---	---
67	4318	---	---	---	---	---	---
68	4189	---	---	---	---	---	---
69	2028	---	---	---	---	---	---
70	5207	6876	8831	---	---	---	---
71	2487	3038	0	---	---	---	---
72	2933	3817	---	---	---	---	---
73	3408	---	---	---	---	---	---
74	1034	---	---	---	---	---	---
75	1208	---	---	---	---	---	---
76	2593	---	---	---	---	---	---
77	1149	---	---	---	---	---	---
78	18878	---	---	---	---	---	---
79	6840	10668	---	---	---	---	---
80	8500	11636	---	---	---	---	---
81	7371	11018	---	---	---	---	---
82	8381	0	---	---	---	---	---
83	6277	6983	7577	8842	10570	13065	15177
84	6848	7412	7973	9366	11237	13473	15537
85	6100	7090	7881	9609	---	---	---
86	9544	6401	[illegible]	9799	---	---	---
87	4787	5190	5626	6444	7559	8853	9478
88	0	0	0	---	---	---	---
89	9178	6354	7499	---	---	---	---
90	9538	6764	8124	---	---	---	---
91	18717	---	---	---	---	---	---
92	15377	---	---	---	---	---	---
93	9501	6097	6970	1169	9569	---	---
94	5181	5896	6462	7193	---	---	---
95	4960	---	---	---	---	---	---
96	7277	---	---	---	---	---	---
97	6660	7926	9440	10953	---	---	---
98	6909	---	---	---	---	---	---
99	3855	---	---	---	---	---	---
100	4513	5001	5522	6146	---	---	---
101	5460	6050	6913	8098	9476	---	---
102	7503	8107	8737	10302	12006	14124	16729
103	7878	8519	9187	10851	12665	14926	17713
104	3000	---	---	---	---	---	---
105	3000	---	---	---	---	---	---
106	3000	---	---	---	---	---	---
107	3000	---	---	---	---	---	---

APPENDIX C

AIRPLANE RUNUP OPERATIONS

This Appendix discusses the adaptation of an existing **INM** equation for use in computing **runup** noise within **INM** Version **4.11**. This equation, also used in the Time-Above-Threshold (**TA**) equation, can be used to approximate the maximum A-weighted sound level (L_{AMAX}) and the maximum tone-corrected perceived noise level ($PNLT_{MAX}$) for a one-second time period as follows:

$$L_{AMAX} = SEL - 10\log_{10}[((500\pi)/(V))(.001R_0)^{(k)}] \text{ and} \qquad (1)$$

$$PNLT_{MAX} = EPNL - 10\log_{10}[((500\pi)/(V))(.001R_0)^{(k)}] + 10, \qquad (2)$$

where

SEL	=	the Sound Exposure Level from the Noise-Power-Distance data base (**dBA**);
EPNL	=	the Effective Perceived Noise Level from the **Noise-Power-**Distance data base (**dB**);
v	=	the airplane velocity (**ft/sec**) ;
R_0	=	the closest point of approach from airplane to receiver (**ft**);
k	=	a constant exponent with a fixed value of **0.6** in the **INM**; and for Equation (**2**),
10	=	a duration correction as **discussed** in Section **2.3**, Equation (**2**).

The above equations assume: (**1**) an approximate shape of an airplane's sound level time history; and (**2**) symmetry in the time history trace around the L_{AMAX} or $PNLT_{MAX}$, as appropriate. The $L_{AMAX}/PNLT_{MAX}$ values computed with these equations were verified using measured $L_{AMAX}/PNLT_{MAX}$ data in the literature.'

Given the computed $L_{AMAX}/PNLT_{MAX}$ and the user-defined duration and location for a **runup**, the **SEL/EPNL** for the **runup** is computed by multiplying the acoustic energy associated with the $L_{AMAX}/PNLT_{MAX}$ by the user-defined duration, and converting the total **runup** energy to a decibel value as follows:

$$SEL_{RUNUP} = 10\log_{10}[(DUR)10\exp(L_{AMAX}/10)] \text{ and} \qquad (3)$$

APPENDIX C

AIRPLANE RUNUP OPERATIONS

This Appendix discusses the adaptation of an existing INM equation for use in computing runup noise within INM Version 4.11. This equation, also used in the Time-Above-Threshold (TA) equation, can be used to approximate the maximum A-weighted sound level (L_{AMAX}) and the maximum tone-corrected perceived noise level ($PNLT_{MAX}$) for a one-second time period as follows:

$$L_{AMAX} = SEL - 10\log_{10}[((500\pi)/(V))(.001R_0)^{(k)}] \text{ and} \qquad (1)$$

$$PNLT_{MAX} = EPNL - 10\log_{10}[((500\pi)/(V))(.001R_0)^{(k)}] + 10, \qquad (2)$$

where SEL = the Sound Exposure Level from the Noise-Power-Distance data base (dBA);

EPNL = the Effective Perceived Noise Level from the Noise-Power-Distance data base (dB);

v = the airplane velocity (ft/sec);

R_0 = the closest point of approach from airplane to receiver (ft);

k = a constant exponent with a fixed value of 0.6 in the INM; and for Equation (2),

10 = a duration correction as discussed in Section 2.3, Equation (2).

The above equations assume: (1) an approximate shape of an airplane's sound level time history; and (2) symmetry in the time history trace around the L_{AMAX} or $PNLT_{MAX}$, as appropriate. The $L_{AMAX}/PNLT_{MAX}$ values computed with these equations were verified using measured $L_{AMAX}/PNLT_{MAX}$ data in the literature.'

Given the computed $L_{AMAX}/PNLT_{MAX}$ and the user-defined duration and location for a runup, the SEL/EPNL for the runup is computed by multiplying the acoustic energy associated with the $L_{AMAX}/PNLT_{MAX}$ by the user-defined duration, and converting the total runup energy to a decibel value as follows:

$$SEL_{RUNUP} = 10\log_{10}[(DUR)10\exp(L_{AMAX}/10)] \text{ and} \qquad (3)$$

directivity pattern discussed in Appendix A is a reasonable approximation of runup directivity.

C.2 References

1 Bishop, D.E., Beckman, J.M., Bucka, M.P., Revision of Civil Aircraft Noise Data for the Integrated Noise Model (INM), Report No. 6039, Project No. 04453, Canoga Park, CA: BBN Laboratories Incorporated, September 1986.

2 A320 Noise Definition Manual NDM, FRANCE: Airbus Industrie, 1990.

3 An Excerpt from the Model B747 Flight Manual, A-Weighted Noise Level Contours, Seattle, WA: Boeing Commercial Airplane Company, 1986.

directivity pattern discussed in Appendix A is a reasonable approximation of runup directivity.

C.2 References

1 Bishop, D.E., Beckman, J.M., Bucka, M.P., Revision of Civil Aircraft Noise Data for the Integrated Noise Model (INM), Report No. 6039, Project No. 04453, Canoga Park, CA: BBN Laboratories Incorporated, September 1986.

2 A320 Noise Definition Manual NDM, FRANCE: Airbus Industrie, 1990.

3 An Excerpt from the Model B747 Flight Manual, A-Weighted Noise Level Contours, Seattle, WA: Boeing Commercial Airplane Company, 1986.

directivity pattern discussed in Appendix A is a reasonable approximation of runup directivity.

C.2 References

1 Bishop, D.E., Beckman, J.M., Bucka, M.P., Revision of Civil Aircraft Noise Data for the Integrated Noise Model (INM), Report No. 6039, Project No. 04453, Canoga Park, CA: BBN Laboratories Incorporated, September 1986.

2 A320 Noise Definition Manual NDM, FRANCE: Airbus Industrie, 1990.

3 An Excerpt from the Model B747 Flight Manual, A-Weighted Noise Level Contours, Seattle, WA: Boeing Commercial Airplane Company, 1986.

```
BEGIN.

SETUP:

  TITLE <ANNUAL AVERAGE EXPOSURE AT AN EXAMPLE OF A MEDIUM HUB AIRPORT>
  AIRPORT <EXAMPLE MHA>

  ALTITUDE 0
  TEMPERATURE 59 F

  RUNWAYS
    RW 09L-27R       0       0          TO  9487    -497   HEADING=93
    RW 27L-09R    4203   -1410          TO -6920   -1044   HEADING=272
    RW  35-17     7355    1366 DT 100   TO  6407    6742

AIRCRAFT:

  TYPES
    AC 747200
    AC DC1030
    AC DC870
    AC A300
    AC 757PW
    AC 727Q15
    AC DC930
    AC MD81
    AC 737300
    AC SABR80
    AC BEC58P
    AC S-76    CURVE=250C30  PARAM=HELI STAGE 1=HORFLT
               CATEGORY=PGA

NOISE  CURVES

  NC 250C30          3 BY 8   3 BY 8
  EPNL
  THRUSTS      1          2         3
       200   90.2       91.2      97.2
       400   85.8       87.2      93.1
       600   83.1       84.5      90.6
      1000   79.4       80.7      87.4
      2000   73.7       75.1      82.6
      4000   67.6       68.2      77.2
      6000   63.1       63.8      73.7
     10000   56.8       57.4      68.7
  SEL
  THRUSTS      1          2         3
       200   88.6       90.0      95.6
       400   84.2       85.6      91.5
       600   81.5       82.9      89.0
      1000   77.8       79.1      85.8
      2000   72.1       73.5      81.0
      4000   66.0       66.6      75.6
      6000   61.5       62.2      72.1
     10000   55.2       55.8      67.1

APPROACH  PARAMETERS

  AP HELI     WEIGHT=10000 ENGINES=2 STOP=1
              FINSP=160  TAXI=160
              LNDFFS=3

INT.NM.

PROFILES  APPROACH

  PF ALT3D SEGMENTS=7
    DISTANCES      20.     10.      5.      3.      1.   -.164  STOP
    ALTITUDES     6000    3236    1644    1007     370      0     0
    SPEEDS      TERMSP  INTSP  APPSP  FINSP  LNDSP  REVSP   TAXI
    THRUSTS     INTFIS APPFAS LNDFFS LNDFLS    REV   IDLE

  PF COPTR SEGMENTS=7
    DISTANCES      3.9     3.1     2.4     1.6     0.8      0      0
    ALTITUDES     2500    2000    1500    1000     500      0      0
    SPEEDS       FINSP   FINSP   FINSP   FINSP   FINSP   FINSP   TAXI
    THRUSTS     LNDFFS  LNDFFS  LNDFFS  LNDFFS  LNDFFS  LNDFFS

ECHO.

FT.

  PROFILES  TAKEOFF

    PF HORFLT SEGMENTS=8 WEIGHT=10000 ENGINES=2
     DISTANCES      0    1376    4126    6876    6877    9626   10000   15000
     ALTITUDES      0       0     500    1000    1000    1500    1500    1500
     SPEEDS        32     160     160     160     160     160     160     160
     THRUSTS        2       2       2       2       1       1       1
```

COMMENTS:

Note: Standard conditions have been defined. To implement the takeoff profile generator see Section 2.1. In addition, the elevation enhancement has not been selected. To implement elevation see Section 2.2.

Note: A runway touch-down point of 1054 ft has been defined for approach operations on Runway 35 (i.e., 100 ft for the user-defined DT plus 954 ft for the fixed touch-down point).

INT.NM.

COMMENTS :

Note: A runup operation has been defined for the B747-200 airplane. The runup takes place at the start of Runway 09L and lasts for 10 seconds, (i.e., in terms of average yearly duration).

TAKEOFFS BY FREQUENCY:

```
  TRACK TR1 RWY 09L STRAIGHT 4.1 LEFT 5 H 1.6 STRAIGHT 50
    OPER 747200 RUNUP 1 D=10 STAGE 1 D=1.1 STAGE 2 D=1.1 STAGE 3 D=1.1
    OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=2.5 STAGE 4 D=2
    OPER 757PW  STAGE 2 D=1.5
    OPER 727Q15 STAGE 1 D=3 N=.5 STAGE 2 D=2.6 N=.6
                STAGE 3 D=1.2 N=.1
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5
                STAGE 3 D=1.5
    OPER MD81   STAGE 2 D=1.0
    OPER 737300 STAGE 1 D=1.5 N=.5

  TRACK TR2 RWY 27R STRAIGHT 4.1 LEFT 88 D 1.6 STRAIGHT 50
    OPER DC1030 STAGE 1 De1.5 STAGE 2 D=3 STAGE 3 D=1
                STAGE 4 D=1 STAGE 5 D=.5 STAGE 6 D=.5
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1
                STAGE 3 D=1 STAGE 4 D=2.5 STAGE 5 D=1
                STAGE 6 D=.5
    OPER A300   STAGE 2 D=2 STAGE 3 D=1
    OPER 727Q15 STAGE 1 D=6 N=1 STAGE 2 D=4.4 N=1.4 STAGE 3 D=1.8
                        N=.4

  TRACK TR3 RWY 09R STRAIGHT 1.3 LEFT 15 D 1.0 STRAIGHT 1.4
                    RIGHT 57 D 1.8 STRAIGHT .5 RIGHT 50 D 1.6
                    STRAIGHT 50
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1 STAGE 3 D=1
                STAGE 4 D=1.5 STAGE 5 D=.5
    OPER 757PW  STAGE 3 D=2.5
    OPER 727Q15 STAGE 1 D=21 N=2.5 STAGE 2 D=16.5 N=4
                STAGE 3 D=8 N=.5
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5
    OPER MD81   STAGE 1 D= 3 N=.5
    OPER 737300 STAGE 2 D=.5

  TRACK TR4 RWY 27R STRAIGHT 4.1 LEFT 230 H 2.2 STRAIGHT 50
    OPER SABR80 STAGE 1 D=3 N=.1

  TRACK TR5 RWY 35 STRAIGHT 50
    OPER SABR80 STAGE 1 D=30.5 N=2.5
    OPER BEC58P STAGE 1 D=13 N=1

  TRACK TR6 RWY 17 STRAIGHT 50
    OPER SABR80 STAGE 1 D=12.5 N=.5
    OPER BEC58P STAGE 1 D=30 N=3

  TRACK TR7 RWY 17 STRAIGHT 1.5 RIGHT 265 H .25 STRAIGHT 3
                  LEFT 245 H 1.0 STRAIGHT 50
    OPER S-76   STAGE 1 D=5
```

LANDINGS BY PERCENTAGE:

```
    OPER 747200 PROF=STD3D D=3 N=0
    OPER DC1030 PROF=STD3D D=22 N=2
    OPER DC870  PROF=ALT3D D=22 N=2
    OPER A300   PROF=STD3D D=2 N=1
    OPER 757PW  PROF=STD3D D=6 N=1
    OPER 727Q15 PROF=ALT3D D=70 N=10
    OPER DC930  PROF=ALT3D D=70 N=4
    OPER MD81   PROF=STD3D D=4 N=.5
    OPER 737300 PROF=STD3D D=1.5 N=.5
    OPER SABR80 PROF=STD3D D=25 N=2
    OPER BEC58P PROF=STD5D D=42 N=5
    OPER S-76   PROF=COPTR D=5

  TRACK TR8 RWY 27R STRAIGHT 50 RIGHT 82 D 1.5 STRAIGHT 4.2
                    PERCENT COM=72 GA=0

  TRACK TR9 RWY 09R HEADING 260 STRAIGHT 50 RIGHT 272 H 1.5
                    STRAIGHT 7 PERCENT COM=28 GA=0

  TRACK TR10 RWY 35 STRAIGHT 50 PERCENT COM=0 GA=30

  TRACK TR11 RWY 17 STRAIGHT 50 PERCENT COM=0 GA=70
```

TOUCHNGOS BY FREQUENCY:

```
  TRACK TR14 RWY 17 STRAIGHT 3 LEFT 180 D 2.0 STRAIGHT 6
                    LEFT 180 D 2.0 STRAIGHT 3
    OPER BEC58P STAGE 1 PROF STD5D D=23
```

```
INT.NM.                                                                        COMMENTS :

TAKEOFFS BY FREQUENCY:

  TRACK TR1 RWY 09L STRAIGHT 4.1 LEFT 5 H 1.6 STRAIGHT 50
    OPER 747200 RUNUP 1 D=10 STAGE 1 D=1.1 STAGE 2 D=1.1 STAGE 3 D=1.1
    OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=2.5 STAGE 4 D=2
    OPER 757PW  STAGE 2 D=1.5
    OPER 727Q15 STAGE 1 D=3 N=.5 STAGE 2 D=2.6 N=.6
                STAGE 3 D=1.2 N=.1
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5
                STAGE 3 D=1.5
    OPER MD81   STAGE 2 D=1.0
    OPER 737300 STAGE 1 D=1.5 N=.5

  TRACK TR2 RWY 27R STRAIGHT 4.1 LEFT 88 D 1.6 STRAIGHT 50
    OPER DC1030 STAGE 1 De1.5 STAGE 2 D=3 STAGE 3 D=1
                STAGE 4 D=1 STAGE 5 D=.5 STAGE 6 D=.5
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1
                STAGE 3 D=1 STAGE 4 D=2.5 STAGE 5 D=1
                STAGE 6 D=.5
    OPER A300   STAGE 2 D=2 STAGE 3 D=1
    OPER 727Q15 STAGE 1 D=6 N=1 STAGE 2 D=4.4 N=1.4 STAGE 3 D=1.8
                            N=.4

  TRACK TR3 RWY 09R STRAIGHT 1.3 LEFT 15 D 1.0 STRAIGHT 1.4
                    RIGHT 57 D 1.8 STRAIGHT .5 RIGHT 50 D 1.6
                    STRAIGHT 50
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1 STAGE 3 D=1
                STAGE 4 D=1.5 STAGE 5 D=.5
    OPER 757PW  STAGE 3 D=2.5
    OPER 727Q15 STAGE 1 D=21 N=2.5 STAGE 2 D=16.5 N=4
                STAGE 3 D=8 N=.5
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5
    OPER MD81   STAGE 1 D= 3 N=.5
    OPER 737300 STAGE 2 D=.5

  TRACK TR4 RWY 27R STRAIGHT 4.1 LEFT 230 H 2.2 STRAIGHT 50
    OPER SABR80 STAGE 1 D=3 N=.1

  TRACK TR5 RWY 35 STRAIGHT 50
    OPER SABR80 STAGE 1 D=30.5 N=2.5
    OPER BEC58P STAGE 1 D=13 N=1

  TRACK TR6 RWY 17 STRAIGHT 50
    OPER SABR80 STAGE 1 D=12.5 N=.5
    OPER BEC58P STAGE 1 D=30 N=3

  TRACK TR7 RWY 17 STRAIGHT 1.5 RIGHT 265 H .25 STRAIGHT 3
                   LEFT 245 H 1.0 STRAIGHT 50
    OPER S-76   STAGE 1 D=5

LANDINGS BY PERCENTAGE:

    OPER 747200 PROF=STD3D D=3 N=0
    OPER DC1030 PROF=STD3D D=22 N=2
    OPER DC870  PROF=ALT3D D=22 N=2
    OPER A300   PROF=STD3D D=2 N=1
    OPER 757PW  PROF=STD3D D=6 N=1
    OPER 727Q15 PROF=ALT3D D=70 N=10
    OPER DC930  PROF=ALT3D D=70 N=4
    OPER MD81   PROF=STD3D D=4 N=.5
    OPER 737300 PROF=STD3D D=1.5 N=.5
    OPER SABR80 PROF=STD3D D=25 N=2
    OPER BEC58P PROF=STD5D D=42 N=5
    OPER S-76   PROF=COPTR D=5

  TRACK TR8 RWY 27R STRAIGHT 50 RIGHT 82 D 1.5 STRAIGHT 4.2
                    PERCENT COM=72 GA=0

  TRACK TR9 RWY 09R HEADING 260 STRAIGHT 50 RIGHT 272 H 1.5
                    STRAIGHT 7 PERCENT COM=28 GA=0

  TRACK TR10 RWY 35 STRAIGHT 50 PERCENT COM=0 GA=30

  TRACK TR11 RWY 17 STRAIGHT 50 PERCENT COM=0 GA=70

TOUCHNGOS BY FREQUENCY:

  TRACK TR14 RWY 17 STRAIGHT 3 LEFT 180 D 2.0 STRAIGHT 6
                    LEFT 180 D 2.0 STRAIGHT 3
    OPER BEC58P STAGE 1 PROF STD5D D=23
```

Note: A runup operation has been defined for the B747-200 airplane. The runup takes place at the start of Runway 09L and lasts for 10 seconds, (i.e., in terms of average yearly duration).

INT.NM.

TAKEOFFS BY FREQUENCY:

```
TRACK TR1 RWY 09L STRAIGHT 4.1 LEFT 5 H 1.6 STRAIGHT 50
  OPER 747200 RUNUP 1 D=10 STAGE 1 D=1.1 STAGE 2 D=1.1 STAGE 3 D=1.1
  OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=2.5 STAGE 4 D=2
  OPER 757PW  STAGE 2 D=1.5
  OPER 727Q15 STAGE 1 D=3 N=.5 STAGE 2 D=2.6 N=.6
              STAGE 3 D=1.2 N=.1
  OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5
              STAGE 3 D=1.5
  OPER MD81   STAGE 2 D=1.0
  OPER 737300 STAGE 1 D=1.5 N=.5

TRACK TR2 RWY 27R STRAIGHT 4.1 LEFT 88 D 1.6 STRAIGHT 50
  OPER DC1030 STAGE 1 De1.5 STAGE 2 D=3 STAGE 3 D=1
              STAGE 4 D=1 STAGE 5 D=.5 STAGE 6 D=.5
  OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1
              STAGE 3 D=1 STAGE 4 D=2.5 STAGE 5 D=1
              STAGE 6 D=.5
  OPER A300   STAGE 2 D=2 STAGE 3 D=1
  OPER 727Q15 STAGE 1 D=6 N=1 STAGE 2 D=4.4 N=1.4 STAGE 3 D=1.8
                    N=.4

TRACK TR3 RWY 09R STRAIGHT 1.3 LEFT 15 D 1.0 STRAIGHT 1.4
                  RIGHT 57 D 1.8 STRAIGHT .5 RIGHT 50 D 1.6
                  STRAIGHT 50
  OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1 STAGE 3 D=1
              STAGE 4 D=1.5 STAGE 5 D=.5
  OPER 757PW  STAGE 3 D=2.5
  OPER 727Q15 STAGE 1 D=21 N=2.5 STAGE 2 D=16.5 N=4
              STAGE 3 D=8 N=.5
  OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5
  OPER MD81   STAGE 1 D= 3 N=.5
  OPER 737300 STAGE 2 D=.5

TRACK TR4 RWY 27R STRAIGHT 4.1 LEFT 230 H 2.2 STRAIGHT 50
  OPER SABR80 STAGE 1 D=3 N=.1

TRACK TR5 RWY 35 STRAIGHT 50
  OPER SABR80 STAGE 1 D=30.5 N=2.5
  OPER BEC58P STAGE 1 D=13 N=1

TRACK TR6 RWY 17 STRAIGHT 50
  OPER SABR80 STAGE 1 D=12.5 N=.5
  OPER BEC58P STAGE 1 D=30 N=3

TRACK TR7 RWY 17 STRAIGHT 1.5 RIGHT 265 H .25 STRAIGHT 3
                 LEFT 245 H 1.0 STRAIGHT 50
  OPER S-76   STAGE 1 D=5
```

LANDINGS BY PERCENTAGE:

```
  OPER 747200 PROF=STD3D D=3 N=0
  OPER DC1030 PROF=STD3D D=22 N=2
  OPER DC870  PROF=ALT3D D=22 N=2
  OPER A300   PROF=STD3D D=2 N=1
  OPER 757PW  PROF=STD3D D=6 N=1
  OPER 727Q15 PROF=ALT3D D=70 N=10
  OPER DC930  PROF=ALT3D D=70 N=4
  OPER MD81   PROF=STD3D D=4 N=.5
  OPER 737300 PROF=STD3D D=1.5 N=.5
  OPER SABR80 PROF=STD3D D=25 N=2
  OPER BEC58P PROF=STD5D D=42 N=5
  OPER S-76   PROF=COPTR D=5

TRACK TR8 RWY 27R STRAIGHT 50 RIGHT 82 D 1.5 STRAIGHT 4.2
                  PERCENT COM=72 GA=0

TRACK TR9 RWY 09R HEADING 260 STRAIGHT 50 RIGHT 272 H 1.5
                  STRAIGHT 7 PERCENT COM=28 GA=0

TRACK TR10 RWY 35 STRAIGHT 50 PERCENT COM=0 GA=30

TRACK TR11 RWY 17 STRAIGHT 50 PERCENT COM=0 GA=70
```

TOUCHNGOS BY FREQUENCY:

```
TRACK TR14 RWY 17 STRAIGHT 3 LEFT 180 D 2.0 STRAIGHT 6
                  LEFT 180 D 2.0 STRAIGHT 3
  OPER BEC58P STAGE 1 PROF STD5D D=23
```

COMMENTS :

Note: A runup operation has been defined for the B747-200 airplane. The runup takes place at the start of Runway 09L and lasts for 10 seconds, (i.e., in terms of average yearly duration).

```
INT.NM.

TAKEOFFS BY FREQUENCY:

  TRACK TR1 RWY 09L STRAIGHT 4.1 LEFT 5 H 1.6 STRAIGHT 50
    OPER 747200 RUNUP 1 D=10 STAGE 1 D=1.1 STAGE 2 D=1.1 STAGE 3 D=1.1
    OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=2.5 STAGE 4 D=2
    OPER 757PW  STAGE 2 D=1.5
    OPER 727Q15 STAGE 1 D=3 N=.5 STAGE 2 D=2.6 N=.6
                STAGE 3 D=1.2 N=.1
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5
                STAGE 3 D=1.5
    OPER MD81   STAGE 2 D=1.0
    OPER 737300 STAGE 1 D=1.5 N=.5

  TRACK TR2 RWY 27R STRAIGHT 4.1 LEFT 88 D 1.6 STRAIGHT 50
    OPER DC1030 STAGE 1 D=1.5 STAGE 2 D=3 STAGE 3 D=1
                STAGE 4 D=1 STAGE 5 D=.5 STAGE 6 D=.5
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1
                STAGE 3 D=1 STAGE 4 D=2.5 STAGE 5 D=1
                STAGE 6 D=.5
    OPER A300   STAGE 2 D=2 STAGE 3 D=1
    OPER 727Q15 STAGE 1 D=6 N=1 STAGE 2 D=4.4 N=1.4 STAGE 3 D=1.8
                        N=.4

  TRACK TR3 RWY 09R STRAIGHT 1.3 LEFT 15 D 1.0 STRAIGHT 1.4
                    RIGHT 57 D 1.8 STRAIGHT .5 RIGHT 50 D 1.6
                    STRAIGHT 50
    OPER DC870  STAGE 1 D=2 N=.5 STAGE 2 D=3.5 N=1 STAGE 3 D=1
                STAGE 4 D=1.5 STAGE 5 D=.5
    OPER 757PW  STAGE 3 D=2.5
    OPER 727Q15 STAGE 1 D=21 N=2.5 STAGE 2 D=16.5 N=4
                STAGE 3 D=8 N=.5
    OPER DC930  STAGE 1 D=26.5 N=.5 STAGE 2 D=8 N=.5 STAGE 3 D=1.5
    OPER MD81   STAGE 1 D= 3 N=.5
    OPER 737300 STAGE 2 D=.5

  TRACK TR4 RWY 27R STRAIGHT 4.1 LEFT 230 H 2.2 STRAIGHT 50
    OPER SABR80 STAGE 1 D=3 N=.1

  TRACK TR5 RWY 35 STRAIGHT 50
    OPER SABR80 STAGE 1 D=30.5 N=2.5
    OPER BEC58P STAGE 1 D=13 N=1

  TRACK TR6 RWY 17 STRAIGHT 50
    OPER SABR80 STAGE 1 D=12.5 N=.5
    OPER BEC58P STAGE 1 D=30 N=3

  TRACK TR7 RWY 17 STRAIGHT 1.5 RIGHT 265 H .25 STRAIGHT 3
                   LEFT 245 H 1.0 STRAIGHT 50
    OPER S-76   STAGE 1 D=5

LANDINGS BY PERCENTAGE:

    OPER 747200 PROF=STD3D D=3 N=0
    OPER DC1030 PROF=STD3D D=22 N=2
    OPER DC870  PROF=ALT3D D=22 N=2
    OPER A300   PROF=STD3D D=2 N=1
    OPER 757PW  PROF=STD3D D=6 N=1
    OPER 727Q15 PROF=ALT3D D=70 N=10
    OPER DC930  PROF=ALT3D D=70 N=4
    OPER MD81   PROF=STD3D D=4 N=.5
    OPER 737300 PROF=STD3D D=1.5 N=.5
    OPER SABR80 PROF=STD3D D=25 N=2
    OPER BEC58P PROF=STD5D D=42 N=5
    OPER S-76   PROF=COPTR D=5

  TRACK TR8 RWY 27R STRAIGHT 50 RIGHT 82 D 1.5 STRAIGHT 4.2
                    PERCENT COM=72 GA=0

  TRACK TR9 RWY 09R HEADING 260 STRAIGHT 50 RIGHT 272 H 1.5
                    STRAIGHT 7 PERCENT COM=28 GA=0

  TRACK TR10 RWY 35 STRAIGHT 50 PERCENT COM=0 GA=30

  TRACK TR11 RWY 17 STRAIGHT 50 PERCENT COM=0 GA=70

TOUCHNGOS BY FREQUENCY:

  TRACK TR14 RWY 17 STRAIGHT 3 LEFT 180 D 2.0 STRAIGHT 6
                    LEFT 180 D 2.0 STRAIGHT 3
    OPER BEC58P STAGE 1 PROF STD5D D=23
```

COMMENTS :

Note: A runup operation has been defined for the B747-200 airplane. The runup takes place at the start of Runway 09L and lasts for 10 seconds, (i.e., in terms of average yearly duration).

1.0 INTRODUCTION

This User Guide is a combined tutorial-manual that comes to you as part of **WINM 4.11**.

2.0 OPERATIONAL REQUIREMENTS

Software/Hardware Requirements

WINM has the same software and hardware requirements as Microsoft Windows 3.x.

3.0 INSTALLATION

Before you start, make sure that you have all the material supplied with WINM 4.11 and check that your equipment matches the list in Chapter 2.

Installation Procedure

WINM comes with four files under the directory \INM4.11. These files will be installed as part of the primary INM installation. They are:

WINM.EXE - The window plot program for INM
INMINPUT.TST - Test case version of input data
CONTOURS.TST - Test case version of contour data
INMCOLOR.DATA - Color control file

Windows Installation of WINM

- Start up Windows by typing WIN.
- Open Windows' ***Program Manager.***
- Open the Windows ***File*** menu. Select ***New.***
- The New ***Program Object*** dialog box will appear.
- Select ***Program Group*** and click on ***OK.***
- The ***Program Group Properties*** dialog box will appear.
- Type **WINM** in the ***Description*** field. Click on OK.
- Open the Windows ***File*** menu. Select ***New.***
- The ***New Program Object*** dialog box will appear.
- Select ***Program Item*** and click on OK.

1.0 INTRODUCTION

This User Guide is a combined tutorial-manual that comes to you as part of **WINM 4.11.**

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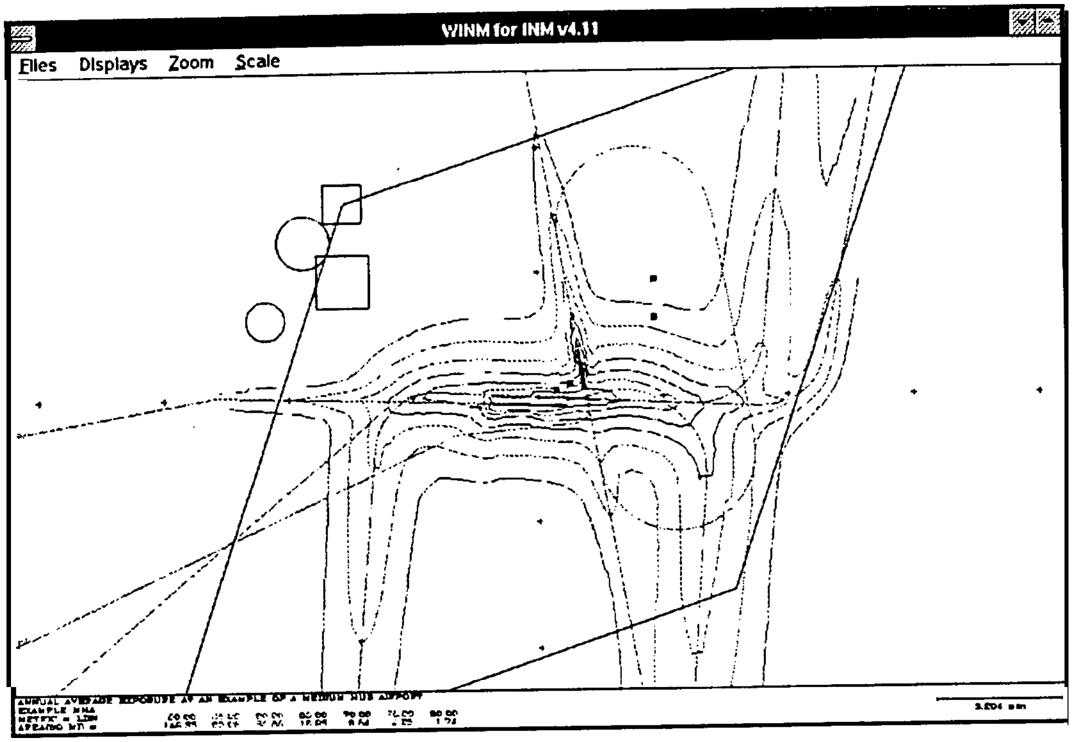
4.0 TUTORIAL

About the Tutorial

The tutorial has been structured so that the exercises will give you progressive familiarity with the operations that you will carry out within WINM 4.11.

4.1 Loading INM Files

The starting point for this exercise is the default screen you see as soon as you start WINM 4.11 from the Windows ***Program Manager.***



By default, WINM uses two default INM input files. To load a different set of input files,

- Place the mouse pointer arrow on ***Files*** in the menu bar; and
- Click once on the left mouse button.
- In the menu, click the mouse pointer on ***Load.***

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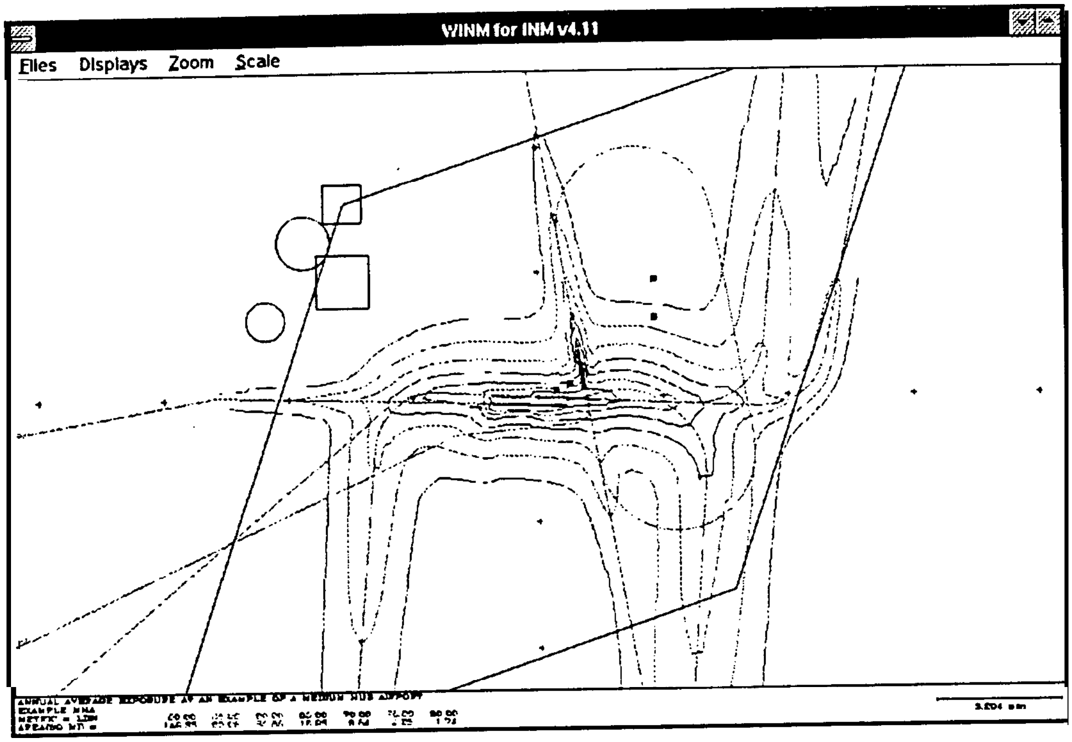

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About the Displays Dialog Box

This menu option allows the user to select which data display information is to be shown. Select any option one at a time and click on ***Apply*** to see its effect immediately. Experiment with as many combinations as you like. Text labels may be independently selected for each displayed item type by clicking on the ***Label*** box next to each item.

4.2.1 Runways

This radio button turns on/off the display of the runways.

4.2.2 Flight Tracks

This radio button turns on/off the display of the flight tracks.

4.2.3 Noise Contours

This radio button turns on/off the display of the noise contours.

4.2.4 Fill Contours

This radio button turns on/off the option to fill the contours.

4.2.5 Noise Sensitive Area

Although every one of these options depends on the INM input files selected, the ***Noise Sensitive Area*** is a special option. This menu option displays user-defined sensitive noise areas. These areas are defined after the END statement of the INM input data file (FOR03.DAT), and each can be either a polygon, square, circle, or point. The area can be defined in NM or FEET and a descriptive text label for label description of the area can be inserted after an asterisk (*) at the end of the line. The user can input/modify these data before or after running the noise model (but not during running the WINM program). The following shows an example of the descriptive text labels as seen in the default INM input filename **'inminput.TST'**:

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4.3 Zoom

About the Zoom Menu

WINM 4.11 offers you the capabilities to zoom in/out of various sections of the display for specialize viewing.

We will now become familiarized with the zooming capabilities within WINM 4.11.

- Place the mouse pointer arrow on ***Zoom*** in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down ***Zoom*** menu appear.

- In the menu, click the mouse pointer on ***Zoom In***.

A zoom box will appear in the center of the screen,

- Move the mouse to expand/shrink the zoom box.
- If you desire to move the zoom area, hold down the right button and drag the zoom box to a different area.
- Click the left button to accept zoom.

Note! At any time, click the right button to cancel the zoom box.

Zoom Out works similar to ***Zoom In***.

- Place the mouse pointer arrow on ***Zoom*** in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down ***Zoom*** menu appear.

- In the menu, click the mouse pointer on ***Zoom Out***.

A zoom box will appear.

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- In the menu, click the mouse pointer on ***Zoom Out***.

A zoom box will appear.

- Move the mouse to expand/shrink the zoom box.
- If you desire to move the zoom area, hold down the right button and drag the zoom box to a different area.

You will see the drop-down ***Scale*** menu appear.

- In the menu, click the mouse pointer on any of the menu selections to see its effect to the scale shown at the bottom right-hand comer.

We have now covered the major capabilities of WINM 4.11.

Let's print the display to a printer.

- Place the mouse pointer arrow on ***Files*** in the menu bar; and
- Click once on the left mouse button.

You will see the drop-down ***Files*** menu appear.

- In the menu, click the mouse pointer on ***Print.*** A submenu will appear.

4.5 Print

About the Print Menu Option

This menu option allows a hard copy output to a printer. The printout will go to the default printer which can be set via **Printers** in **Control Panel.**

- **Actual Scale**

  This menu option allows the user to print the current screen for scaling. The scale unit will reflect 1 inch on the hardcopy printout.

- **Screen Zoom**

  This menu option allows the user to print the current screen at the current zoom factor. The left and right edges of the hardcopy printout will be set to match the left and right edges of the screen display. If the printer's page orientation is set to 'Landscape' in the Windows ***Print Manager,*** then the top and bottom edges of the hardcopy printout will be set to match the top and bottom edges of the screen display as well.

To print what is displayed, select ***Screen Zoom***

You can now exit the program.

You will see the drop-down ***Scale*** menu appear.

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6.0 Program Limitation.

- Maximum 2000 points per noise contour.
- Runways information input is in FEET (from INM input file).
- Tracks information input is in NM (from INM input file).
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and Energy
Washington, DC 20591

INM

Integrated Noise Model Version 4.11

User's Guide - Supplement

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